PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
48962/ML/MM		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/FI99/00794	28/09/1999	29/09/1998
International Patent Classification (IPC) or national classification and IPC H04Q7/38		
Applicant NOKIA NETWORKS OY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 21 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25/04/2000	16.01.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Reeck, G Telephone No. +49 89 2399 7308

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/FI99/00794

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-19	with telefax of	03/11/2000

Claims, No.:

1-9	with telefax of	03/11/2000

Drawings, sheets:

1/6-6/6	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-9
	No:	Claims
Inventive step (IS)	Yes:	Claims 5-7
	No:	Claims 1-4, 8, 9
Industrial applicability (IA)	Yes:	Claims 1-9
	No:	Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

   D1: US-A-5 497 504 (ACAMPORA ANTHONY S ET AL) 5 March 1996 (1996-03-05)
   D2: US-A-5 666 348 (THORNBERG CARL MAGNUS ET AL) 9 September 1997 (1997-09-09)

2. Document D1 (see in particular column 5, lines 28-42; column 6, line 41 - column 7, line 14; column 7, line 31 - column 8, line 13; Fig.2 and 5) is regarded as being the closest prior art to the subject-matter of **Claim 1**, and discloses (the references in parentheses applying to this document):
   an admission control method for handling bearer requests (column 7, lines 32-33: "The process...to administer the call admission control"; Fig.5) in a cellular telecommunications network (column 2, lines 41-42: mobile communications system), wherein a bearer request (column 7, line 39: call request) is sequentially tested with a test of a first kind (column 7, lines 54-57; Fig.5, step 509) in a similar way for all bearer requests (Fig.5, step 501: any call request), and the bearer request is tested with a test of a second kind for monitoring bearers according to a particular policy (column 7, line 65: "reviews the local policies"; column 8, lines 3-5; Fig.5, step 515), the admission of the bearer request being dependent on the results of both the test of the first kind and the test of the second kind (Fig.5, steps 511 and 517).

2.1 The subject-matter of **Claim 1** is distinguished from the disclosure of D1 in that it makes a distinction between so called "controllable" traffic load components (i.e. traffic caused by non-real-time bearers that the network can transmit immediately or that it can delay according to the available capacity) and so called "non-controllable" traffic load components (i.e. traffic caused by real-time bearers).

2.2 However, document D1 also teaches a classification of call requests (column 5, lines 28-42) in quite a similar manner as the present application (page 4, line 32 - page 5, line 3). Furthermore, these different call classes are taken into account while applying the test of a second kind according to a particular policy (column 7, lines 63-67).

Thus, in applying the disclosure of document D1, the skilled person would arrive in an obvious way at the subject-matter of Claim 1.

2.3 Therefore, the subject-matter of **Claim 1** does not involve an inventive step and thus Claim 1 does not satisfy the criterion set forth in Article 33(3) PCT.

3. The same objection is also valid for the network element according to **independent Claim 8** representing the same combination of features as method Claim 1, but formulated as an apparatus.

Thus, the subject-matter of **independent Claim 8** does also not involve an inventive step and does not satisfy the requirement of Article 33(3) PCT.

4. The **dependent Claims 2-4 and 9** do not contain any features which, in combination with the features of the claims to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

4.1 The feature of **dependent Claim 2,** relating to statistical properties of bearers as a basis for the test of the first kind, has already been disclosed in document D1 (see in particular column 7, lines 2-5 and the different QoS metrics according to Claims 3-6).

4.2 Furthermore, the feature of **dependent Claim 3,** relating to the test of the second kind comparing the number of currently existing high load bearers to a predefined threshold, has already been employed for a similar method in document D1 (see in particular column 2, lines 54-62; column 3, lines 39-40).

4.3 Moreover, the feature of **dependent Claim 4,** relating to the test of the second kind comparing the sum of bit rates of currently existing high load bearers and of the requested bearer to a predefined threshold, is merely one straightforward possibility for the skilled person to implement a criterion for such a test. Furthermore, D2 (see in particular column 2, lines 48-53) already discloses the sum of data traffics as a determination criterion.

4.4 Likewise, the feature of **dependent Claim 9,** relating to the claimed network element being a radio network controller, is only a design choice for the person skilled in network architecture and control, in order to implement the claimed tests and decision, and has already been disclosed in document D2 (see in particular Fig.1 and column 8, lines 53-56).

5. However, the features of the **dependent Claims 5-7**, in combination with the features of Claim 1, represent a contribution over the prior art.

5.1 In this respect, Claim 5 relates to a change of the admission criteria of the test of a first kind according to the results of the test of a second kind.

5.2 This feature results in an inter-dependency of the tests of the first and second kind.

Hence, the technical problem solved is the provision of a more variable admission control method.

5.3 There is neither any hint in documents D1 or D2, taken alone or in combination, to provide an inter-dependency of the tests of the first and second kind, nor does this knowledge fall within the normal design competence of the person skilled in the art.

Dependent Claim 5 meets therefore the requirements of novelty and inventive step and thus satisfies the criterion set forth in Article 33(1)-(4) PCT.

5.4 **Claims 6 and 7** are dependent on Claim 5 and, as such, also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VII

Certain defects in the international application

On page 11, lines 28-31 the same sentence is printed twice which is obviously not intended.

Re Item VIII

Certain observations on the international application

The term "essentially" used in Claim 1 (page 20, line 9) is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear (Article 6 PCT and PCT Guidelines III-4.5 and 4.6).

MM/MC

WO 00/19760
PCT/FI99/00794

By Express Mail
No. EL726283277US

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

Berggren Oy Ab

14 -04- 2000

Date of mailing (day/month/year) 06 April 2000 (06.04.00)	
Applicant's or agent's file reference 48962	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/FI99/00794	28 September 1999 (28.09.99)	29 September 1998 (29.09.98)

Applicant
NOKIA NETWORKS OY et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   06 April 2000 (06.04.00) under No. WO 00/19760

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

Berggren Oy Ab
13 -06- 2000
HL

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

Date of mailing (day/month/year) 31 May 2000 (31.05.00)	
Applicant's or agent's file reference 48962	**IMPORTANT INFORMATION**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/FI99/00794	28 September 1999 (28.09.99)	29 September 1998 (29.09.98)

Applicant
NOKIA NETWORKS OY et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   AP :GH,GM,KE,LS,MW,SD,SL,SZ,TZ,UG,ZW
   EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :AU,BG,BR,CA,CN,CZ,DE,IL,JP,KP,KR,MN,NO,NZ,PL,RO,RU,SE,SK,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
   OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
   National :AE,AL,AM,AT,AZ,BA,BB,BY,CH,CR,CU,DK,DM,EE,ES,FI,GB,GD,GE,GH,GM,
   HR,HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MW,MX,PT,SD,SG,SI,
   SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing , if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:
R. E. Stoffel

Telephone No. (41-22) 338.83.38

M.M/ Mc

By Express Mail
No. EL726283277US

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

BERGGREN OY AB
P.O. Box 16
00101 Helsinki Berggren Oy Ab
FINLANDE

22 -05- 2000

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence and Administrative Instructions, Section 601(a))

Date of mailing *(day/month/year)*	18.05.00
Applicant's or agent's file reference: 48962	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/FI 99/00794	28/09/1999	29/09/1998

Applicant

NOKIA NETWORKS OY et al.

1. The applicant is hereby **notified** that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

25/04/2000

2. This date of receipt is:

- [X] the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- [ ] the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- [ ] the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. [ ] **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

[ ] *(If applicable)* This notification confirms the information given by telephone, facsimile transmission or in person on:

_____

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	NOVELLI C Tel. (+49-89) 2399-8641

EUROPÄISCHES PATENTAMT · EUROPEAN PATENT OFFICE · OFFICE EUROPÉEN DES BREVETS

PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

Berggren Oy Ab
-8 -12- 1999
BW

Date of mailing (day/month/year) 29 November 1999 (29.11.99)	
Applicant's or agent's file reference 48962	**IMPORTANT NOTIFICATION**
International application No. PCT/FI99/00794	**International filing date** (day/month/year) 28 September 1999 (28.09.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
NOKIA TELECOMMUNICATIONS OY P.O. Box 300 FIN-00045 Nokia Group Finland	FI	FI
	Telephone No. +358-9-51121	
	Facsimile No. +358-9-51127981	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
NOKIA NETWORKS OY P.O. Box 300 FIN-00045 Nokia Group Finland	FI	FI
	Telephone No. +358-9-51121	
	Facsimile No. +358-9-51127981	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[X] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[ ] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer P. Regis
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

002980030

PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

From the INTERNATIONAL BUREAU

PCT

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

Berggren Oy Ab
16 -12- 1999

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

Date of mailing (day/month/year) 07 December 1999 (07.12.99)	
Applicant's or agent's file reference 48962	**IMPORTANT NOTIFICATION**
International application No. PCT/FI99/00794	International filing date (day/month/year) 28 September 1999 (28.09.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 29 September 1998 (29.09.98)
Applicant NOKIA NETWORKS OY et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
29 Sept 1998 (29.09.98)	982091	FI	06 Dece 1999 (06.12.99)

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Carlos Naranjo
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

By Express Mail
No. EL726283277US

PCT REQUEST

48962

Original (for **SUBMISSION**) - printed on 28.09.1999 12:39:59 PM

0 0-1	**For receiving Office use only** International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	

0-4 0-4-1	**Form - PCT/RO/101 PCT Request** Prepared using	PCT-EASY Version 2.84 (updated 01.07.1999)
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	National Board of Patents and Registration (Finland) (RO/FI)
0-7	**Applicant's or agent's file reference**	48962
I	**Title of invention**	ADMISSION CONTROL METHOD
II II-1 II-2 II-4 II-5 II-6 II-7 II-8 II-9	**Applicant** This person is: Applicant for Name Address: State of nationality State of residence Telephone No. Facsimile No.	applicant only all designated States except US NOKIA TELECOMMUNICATIONS OY P.O. Box 300 FIN-00045 Nokia Group Finland FI FI +358-9-51121 +358-9-51127981
III-1 III-1-1 III-1-2 III-1-4 III-1-5 III-1-6 III-1-7	**Applicant and/or inventor** This person is: Applicant for Name (LAST, First) Address: State of nationality State of residence	applicant and inventor US only LAAKSONEN, Niina Nuottaniementie 25 B 5 FIN-02230 Espoo Finland FI FI

PCT REQUEST 48962

Original (for **SUBMISSION**) - printed on 28.09.1999 12:39:59 PM

IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	BERGGREN OY AB
IV-1-2	Address:	P.O. Box 16 FIN-00101 Helsinki Finland
IV-1-3	Telephone No.	+358-9-693701
IV-1-4	Facsimile No.	+358-9-6933944
IV-1-5	e-mail	email.box@berggren.elisa.fi
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW SD SL SZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AL AM AT AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

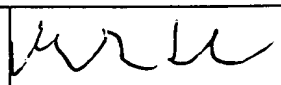
PCT REQUEST 48962

Original (for **SUBMISSION**) - printed on 28.09.1999 12:39:59 PM

V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	**Exclusion(s) from precautionary designations**	NONE	
VI-1	**Priority claim of earlier national application**		
VI-1-1	Filing date	29 September 1998 (29.09.1998)	
VI-1-2	Number	982091	
VI-1-3	Country	FI	
VI-2	**Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	**International Searching Authority Chosen**	European Patent Office (EPO) (ISA/EP)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	19	-
VIII-3	Claims	2	-
VIII-4	Abstract	1	48962.txt
VIII-5	Drawings	6	-
VIII-7	TOTAL	32	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-17	Other (specified):	Copy of official action in FI 982091	-
VIII-18	**Figure of the drawings which should accompany the abstract**	1	
VIII-19	**Language of filing of the international application**	English	

PCT REQUEST 48962

Original (for **SUBMISSION**) - printed on 28.09.1999 12:39:59 PM

IX-1	**Signature of applicant or agent**	
IX-1-1	Name	BERGGREN OY AB
IX-1-2	Name of signatory	Markus Levlin
IX-1-3	Capacity	Patent Agent

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	
10-2	**Drawings:**	
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/EP
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

From the INTERNATIONAL SEARCHING AUTHORITY

To:
BERGGREN OY AB
P.O. Box 16
00101 Helsinki
FINLAND

Berggren Oy Ab
-2 -02- 2000

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 48962	Date of mailing *(day/month/year)* 28/01/2000 28/3-00/44 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/FI 99/ 00794	International filing date *(day/month/year)* 28/09/1999
Applicant NOKIA NETWORKS OY	

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Johannes Ligtvoet

Form PCT/ISA/220 (July 1998)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (cont[illegible])

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped),whether

(i) the claim is unchanged;

(ii) the claim is cancelled;

(iii) the claim is new;

(iv) the claim replaces one or more claims as filed;

(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international appplication is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

INSDOCID: <XSISA220NOENP4_I_>

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
48962		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/FI 99/ 00794	28/09/1999	29/09/1998
Applicant		
NOKIA NETWORKS OY		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/FI 99/00794

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 497 504 A (ACAMPORA ANTHONY S ET AL) 5 March 1996 (1996-03-05) column 5, line 28 - line 42 column 6, line 41 -column 7, line 14 column 7, line 31 -column 8, line 13 figure 5 ---	1-3,8,9
A	US 5 666 348 A (THORNBERG CARL MAGNUS ET AL) 9 September 1997 (1997-09-09) column 2, line 25 - line 58 column 13, line 6 - line 43 -----	1,8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2000	28/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dionisi, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/FI 99/00794

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5497504 A	05-03-1996	AU 2588695 A	05-12-1995
		WO 9531868 A	23-11-1995
US 5666348 A	09-09-1997	AU 7005196 A	09-04-1997
		CN 1201583 A	09-12-1998
		EP 0852102 A	08-07-1998
		JP 11512593 T	26-10-1999
		WO 9711570 A	27-03-1997

PATENTTI- JA REKISTERIHALLITUS
Patentti- ja innovaatiolinja

TUTKIMUSRAPORTTI

PATENTTIHAKEMUS NRO	LUOKITUS
982091	H04Q 7/22, 7/38

TUTKITTU AINEISTO

Patenttijulkaisukokoelma (FI, SE, NO, DK, DE, CH, EP, WO, GB, US), tutkitut luokat

Tiedonhaut ja muu aineisto

Epoque -tietokannat: Epodoc, WPI, Paj, Full Text

Inspec -tietokanta

Internet -selailua

VIITEJULKAISUT

Kategoria*)	Julkaisun tunnistetiedot	Koskee vaatimuksia
A	EP-A2-767548, AT&T Corp., 9.4.97, H04B 7/26	
A	DE-C1-4134476, Telenorma GmbH, 6.5.93, H04L 12/56	

*) X Patentoitavuuden kannalta merkittävä julkaisu yksinään tarkasteltuna
Y Patentoitavuuden kannalta merkittävä julkaisu, kun otetaan huomioon tämä ja yksi tai useampi samaan kategoriaan kuuluva julkaisu
A Yleistä tekniikan tasoa edustava julkaisu, ei kuitenkaan patentoitavuuden este

Päiväys	Tutkija
7.9.1999	Seppo Ojala

PATENT COOPERATION TREATY

By Express Mail
No. EL726283277US

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
BERGGREN OY AB
P.O. Box 16
00101 Helsinki
FINLANDE

Berggren Oy Ab
07 -08- 2000
mm /ML

PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing *(day/month/year)*	03.08.2000
Applicant's or agent's file reference 48962/ML/MM	**REPLY DUE** **within 3 month(s)** from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/FI99/00794	28/09/1999	29/09/1998

International Patent Classification (IPC) or both national classification and IPC
H04Q7/38 3.11.00 jas

Applicant
NOKIA NETWORKS OY et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

I	☒	Basis of the opinion
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain document cited
VII	☒	Certain defects in the international application
VIII	☒	Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 29/01/2001.

Name and mailing address of the international preliminary examining authority:
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer / Examiner
Reeck, G

Formalities officer (incl. extension of time limits)
Finnie, A
Telephone No. +49 89 2399 8251

I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*):

Description, pages:

1-19 as originally filed

Claims, No.:

1-9 as originally filed

Drawings, sheets:

1/6-6/6 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	
Inventive step (IS)	Claims	1-4, 8, 9
Industrial applicability (IA)	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

   D1: US-A-5 497 504 (ACAMPORA ANTHONY S ET AL) 5 March 1996 (1996-03-05)
   D2: US-A-5 666 348 (THORNBERG CARL MAGNUS ET AL) 9 September 1997 (1997-09-09)

2. Document D1 (see in particular column 5, lines 28-42; column 6, line 41 - column 7, line 14; column 7, line 31 - column 8, line 13; Fig.2 and 5) is regarded as being the closest prior art to the subject-matter of **Claim 1**, and discloses (the references in parentheses applying to this document):
   an admission control method (column 7, lines 32-33: "The process...to administer the call admission control"; Fig.5) in a cellular telecommunications network (column 2, lines 41-42: mobile communications system), wherein a bearer request (column 7, line 39: call request) is tested with a test of a first kind (column 7, lines 54-57; Fig.5, step 509), and the bearer request is tested with a test of a second kind for monitoring bearers according to a particular policy (column 7, line 65: "reviews the local policies"; column 8, lines 3-5; Fig.5, step 515), the admission of the bearer request being dependent on the results of both the test of the first kind and the test of the second kind (Fig.5, steps 511 and 517).

2.1 The subject-matter of Claim 1 differs from that disclosed in D1 in the particularisation of that policy to the case of presenting to the network a load which exceeds a predefined threshold.

2.2 However, this is merely one of several possibilities to be considered by a person skilled in the resource management of a cellular telecommunications network in order to implement such a policy, taking into account certain criteria already suggested in D1, including e.g. the bandwidth of the requested connection, wherein the local policy (step 515) "may particularize the proportions of the cell bandwidth which need to be maintained among the different classes of connections" (column 7, line 59 - column 8, line 3; Fig.5).

Thus, the skilled person would arrive in an obvious way at the subject-matter of Claim 1.

2.3 Therefore, the subject-matter of **Claim 1** does not involve an inventive step and thus Claim 1 does not satisfy the criterion set forth in Article 33(3) PCT.

3. The same objection is also valid for the network element according to **independent Claim 8** representing the same combination of features as method Claim 1, but formulated as an apparatus.

Thus, the subject-matter of **independent Claim 8** does also not involve an inventive step and does not satisfy the requirement of Article 33(3) PCT.

4. The **dependent Claims** do not contain any features which, in combination with the features of the claims to which they refer, meet the requirements of the PCT in respect of novelty or inventive step, the reasons being as follows:

4.1 The feature of **dependent Claim 2,** relating to statistical properties of bearers as a basis for the test of the first kind, has already been disclosed in document D1 (see in particular column 7, lines 2-5 and the different QoS metrics according to Claims 3-6).

4.2 Furthermore, the feature of **dependent Claim 3,** relating to the test of the second kind comparing the number of currently existing high load bearers to a predefined threshold, has already been employed for a similar method in document D1 (see in particular column 2, lines 54-62; column 3, lines 39-40).

4.3 Moreover, the feature of **dependent Claim 4,** relating to the test of the second kind comparing the sum of bit rates of currently existing high load bearers and of the requested bearer to a predefined threshold, is merely one straightforward possibility for the skilled person to implement a criterion for such a test. Furthermore, D2 (see in particular column 2, lines 48-53) already discloses the sum of data traffics as a determination criterion.

4.4 Likewise, the feature of **dependent Claim 9,** relating to the claimed network element being a radio network controller, is only a design choice for the person skilled in network architecture and control, in order to implement the claimed tests and decision, and has already been disclosed in document D2 (see in particular Fig.1 and column 8, lines 53-56).

Re Item VII

Certain defects in the international application

1. The cited documents D1 and D2 should be acknowledged and briefly discussed in the opening part of the description (Rule 5.1(a)(ii) PCT), so as to put the invention into the proper perspective. Following from their disclosure, the statement of problem in the introductory part of the description should be revised (PCT Guidelines II-4.4 and 4.6).

2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

3. The application should also be revised with an aim at correcting possible typing errors (e.g. "threshold" all over the application; "resources" instead of "bearers" on page 3, line 27, last word; page 8, line 33: "described"; page 18, line 16: "controller" missing after "network"; "523, 524, 525" instead of "523, 524, 524" on page 18, line 37; etc.).

4. Care should be taken during the revision not to add subject-matter which extends beyond the content of the application as originally filed (Article 34(2)(b) PCT).

Re Item VIII

Certain observations on the international application

1. The present independent Claims 1 and 8 do not meet the requirement following from Article 6 PCT taken in combination with Rule 6(3)(b) PCT that any independent claim must contain all the technical features essential to the invention.

1.1 In particular, it is clear from the description (see page 3, lines 29-31; page 4, lines 3-5) that the test of the second kind is used for monitoring bearers, which present to the network a load which exceeds a predefined threshold.
This feature is not present in current Claim 8.

1.2 Furthermore, there is always a predefined order in executing both tests, see Fig.1 and Fig.2, i.e. both tests should be executed one after the other and never e.g. in parallel, which could be possible according to the present wording of Claims 1 and 8.

1.3 In addition, according to the description (see page 4, lines 2-3), the test of the first kind "is used for overall control, i.e. all bearers are treated in a roughly similar way". This functional feature defining the test of the first kind is not present in the current Claims 1 and 8.

1.4 Therefore, any independent claim representing the method or network element according to the present application should include these technical features, which are regarded as essential for the definition and performance of the invention (PCT Guidelines III-4.1, 4.2 and 4.3).

2. The independent Claims 1 and 8 refer to the feature "a telecommunications network", while throughout the description all corresponding references relate to "a cellular telecommunications network" (see e.g. page 1, line 12; page 3, line 2; page 5, line 30; page 6, line 3; page 18, lines 10; 23; 27; page 19, line 16). This leaves the reader in doubt as to the intended meaning of "a telecommunications network" which in the claims is broader than justified by the extent of the description and drawings, thereby rendering the definition of the subject-matter of Claims 1 and 8 unclear (Article 6 PCT and PCT Guidelines III-4.1 and III-6.1).

Claims 1 and 8 should hence be amended also with an aim at removing this intrinsical inconsistency.

3. The term "especially" used in Claim 1 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear (Article 6 PCT and PCT Guidelines III-4.5 and 4.6).

4. The vague and imprecise statement in the description on page 19, lines 11 - 14 implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a). This statement should therefore be deleted.

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

By Express Mail
No. EL726283277US

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference: 48962/ML/MM
International application No.: PCT/FI99/00794	International filing date *(day/month/year)*: 28 September 1999 (28.9.99)	(Earliest) Priority date *(day/month/year)*: 29 September 1998 (29.9.98)

Title of invention:
ADMISSION CONTROL METHOD

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*	Telephone No.:
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☐ Further applicants are indicated on a continuation sheet.

International application No.
PCT/FI99/00794

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is [x] agent [ ] common representative

and [x] has been appointed earlier and represents the applicant(s) also for international preliminary examination.

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

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Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

[ ] the international application as originally filed

the description [ ] as originally filed
[ ] as amended under Article 34

the claims [ ] as originally filed
[ ] as amended under Article 19 (together with any accompanying statement)
[ ] as amended under Article 34

the drawings [ ] as originally filed
[ ] as amended under Article 34

2. [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. [ ] The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

[x] which is the language in which the international application was filed.
[x] which is the language of a translation furnished for the purposes of international search.
[x] which is the language of publication of the international application.
[ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby **elects all eligible States** *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes **not to elect:**

International application No.
PCT/FI99/00794

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	sheets	☐	☐
6. other *(specify)*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. [X] fee calculation sheet
2. [ ] separate signed power of attorney
3. [ ] copy of general power of attorney, reference number, if any:
4. [ ] statement explaining lack of signature
5. [ ] nucleotide and or amino acid sequence listing in computer readable form
6. [ ] other *(specify)*:

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

BERGGREN OY AB

25 April 2000

Markus Levlin
Patent Agent

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1. Date of actual receipt of DEMAND:
2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):
3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.
4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

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Demand received from IPEA on:

See Notes to the demand form

PCT

CHAPTER II

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International application No.	PCT/FI99/00794
Applicant's or agent's file reference	48962/ML/MM

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Date stamp of the IPEA

Applicant

NOKIA NETWORKS OY

Calculation of prescribed fees

1. Preliminary examination fee	EUR 1533	P
2. Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)*	EUR 147	H
3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box.....	EUR 1680	TOTAL

Mode of Payment

- [ ] authorization to charge deposit account with the IPEA (see below)
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- [ ] bank draft
- [ ] cash
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- [ ] coupons
- [X] other *(specify)*: Bank transfer to account 157230-340380

Deposit Account Authorization *(this mode of payment may not be available at all IPEAs)*

The IPEA _____

- [ ] is hereby authorized to charge the total fees indicated above to my deposit account.
- [ ] *(this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)* is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

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3 November 2000

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(3+22 pages)

Authorized Officer: Reeck, G
Our ref: 48962/MB/PKK

REPLY TO WRITTEN OPINION
INTERNATIONAL PATENT APPLICATION PCT/FI99/00794
APPLICANT: NOKIA NETWORKS OY
Due Date: 3 November 2000

On account of the Written Opinion issued on 3 August 2000 we submit the following:

The Examiner is right in stating that the original wide formulation of the indepedent claims indeed covers also such solutions that are possible to arrive at from the teachings of D1 without an inventive step. The applicant is ready to limit the scope of the independent claims in order to remedy this deficiency.

An important feature of the present invention is the fact that access requests may be separately analysed with regard to the controllable and/or non-controllable load they would present to the network. From page 4, line 32, to page 5, line 3 there is a passage in the description that explains the difference between controllable and non-controllable load. Additionally it is said on the two last lines of said passage that it is the non-controllable load that is preferably used "as a basis of predictions", because this is the part of the load that the network can not avoid taking responsibility of. This means that even if an access request would represent a combination of controllable and non-controllable traffic load, the admission control algorithm may separate these two from each other and handle the access request as if it represented only a certain non-controllable load component.

Let us analyse the disclosure of D1 and D2 with respect to controllability or non-controllability. The two-step test of D1 is most illustratively presented in fig. 5 and the associated description from line 35 of column 7 to line 13 of column 8. The first test of D1 is a simple check on the number of already admitted connections (ref. design.'s 505, 507 and 509): if a connection of a specific type has been requested and there already exist a maximum number of connections of that type, the access request is immediately refused. The second test at step 515 checks, whether "local policies" are satisfied. Of these, D1

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teaches from line 65 of column 7 to line 3 of column 8 that they include "the sharing and scheduling policies of the different call classes in the cell". In other words, even if a cell could accommodate a connection of a specific type by looking just the number of connections of that type, it may happen that there does not exist a predefined amount or form of allocatable radio capacity in a pool of resources fixed for that type of connections, in which case the admission control algorithm again refuses the access request.

The teaching of D1 does not make any difference between the controllable or non-controllable load components represented by the access request. It simply handles the access request as a representative of the bulk of a connection of a certain type. The access request is either granted as a whole or refused, which means that the connection either gets all the capacity it requested or none of it.

D2 discusses the subject of granting or rejecting admission requests to packet channels. When an admission control function receives a new admission request, it checks a priority value and an estimated data traffic indicator from the request. From the existing packet calls the admission control function selects those for consideration that have a priority value that is at least as high as that contained in the new admission request. It calculates the sum of estimated data traffic from these existing packet calls plus the estimated data traffic of the newly received request. If this sum is less than a maximum tolerable traffic level, it grants admission for the new packet call. An audaciously broad interpretation of this teaching might say that the selection of existing packet calls according to priority value is a first test step and the calculation of the estimated data traffic levels is the second, but the applicant agrees with the Examiner in that the pertinence of D2 is restricted to an anticipation of the use of estimated data traffic sums as a decision criterion for an admission control function.

We have thus shown that the subject of treating controllable or non-controllable load separately is not disclosed in either D1 or D2. There remains the task of formulating new independent claims so that they clearly recite this feature as a characteristic feature of the invention, in addition to remedying the deficiencies pointed at in paragraphs Item VII 2 as well as Item VIII 1-3 of the Written Opinion.

The new formulation that the applicant proposes for the independent claims is seen in the appended set of amended claims. Proceeding through the new independent claims from top to down, the following amendments should be noted:

1. The independent method claim is specified to handle "an admission control method for handling bearer requests". The whole application as filed supports such an additional detail.

2. The definition "a telecommunications network" has been specified to read "a cellular telecommunications network" throughout the claims (Item VIII,

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paragraph 2). Additionally the cellular telecommunications network is said to "support bearers that are allowed to comprise controllable load components in addition to non-controllable traffic load components". The latter amendment has basis in the application as filed from page 4, line 32, to page 5, line 3. The fact that bearers are allowed to comprise controllable load components in addition to non-controllable traffic load components is not new as such, which justifies placing this additional limitation to the preamble of the independent claims.

3. The method claims are rewritten into the commonly used form of method steps, and all claims are amended to contain reference designators in parentheses. The latter meets the requirements of Item VII, paragraph 2.

4. The method steps are recited to be executed "sequentially" (Item VIII, paragraph 1.2). This amendment has basis in the application as filed in figs. 1 and 2.

5. The test of a first kind is now required to "set criteria for non-controllable traffic load components". This amendment has basis in the application as filed on page 6, lines 21-22. Additionally the first test is required to set these criteria "in an essentially similar way for all bearer requests" (Item VIII, paragraph 1.3).

6. The test of a second kind is now required to monitor "[especially] bearers that present to the network a non-controllable load component which exceeds a predefined threshold". This amendment has basis in the application as filed on page 5, line 2; deleting the word "especially" meets the requirements of Item VIII, paragraph 3. Introducing said features also to claim 8 meets the requirements of Item VIII, paragraph 1.1.

In addition to the claim amendments described above, the cited documents D1 and D2 are now acknowledged and briefly discussed in the opening part of the description (Item VII, paragraph 1). The typographical errors pointed at in Item VII, paragraph 3 have been corrected. The statement at the end of page 19 has been corrected into a form that is believed not to be contrary to Article 6 PCT.

Since all defencies of the application that were taken up in the Written Opinion have been corrected, we respectfully request a positive reconsideration of the merits of the application in its amended form.

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Admission control method

TECHNICAL FIELD OF THE INVENTION

The invention is related to radio resource usage in cellular telecommunication systems, more accurately to admission control methods used in establishing of new connections.

BACKGROUND OF THE INVENTION

In cellular telecommunication systems a single speech connection or data connection through the cellular telecommunication network is called a bearer. Generally, a bearer is associated with a set of parameters pertaining to data communication between a certain terminal equipment and a network element, such as a base station or an interworking unit (IWU) connecting the cellular network to another telecommunications network. The set of parameters associated with a bearer comprises typically for example data transmission speed, allowed delays, allowed bit error rate (BER), and the minimum and maximum values for these parameters. A bearer may further be a packet transmission bearer or a circuit switched bearer and support for example transparent or non-transparent connections. A bearer can be thought of as a data transmission path having the specified parameters connecting a certain mobile terminal and a certain network element for transmission of payload information. One bearer always connects only one mobile terminal to one network element. However, a bearer can pass through a number of network elements. One mobile communication means (ME, Mobile Equipment) may in some cellular telecommunication systems support one bearer only, in some other systems also more than one simultaneous bearers.

In order to be able to transmit information in a desired way, connections over the radio interface have to obtain a desired level of quality. The quality can be expressed for example as the C/I i.e. Carrier to Interference ratio, which indicates the ratio of received carrier wave power to received interfering power. Other measures for the quality of a connection are SIR i.e. Signal to Interference ratio, S/N i.e. Signal to Noise ratio, and S/(I+N) i.e. Signal to Noise plus Interference ratio. The bit error rate (BER) or frame error rate (FER) are also used as measures of connection quality. Typically, a certain target level for one of these or other corresponding measures is determined beforehand, and for each connection, the

transmission power is adjusted to be such that the target level is reached as closely as possible. The transmission power should not be higher than what is necessary for obtaining the desired target level, since a too high transmission level wastes electrical energy in the transmitting equipment, which is crucial with handheld mobile stations, and causes interference to other connections.

Admission control is a crucial function in ensuring, that each bearer obtains the desired SIR level. The purpose of admission control is to examine each new request for a new bearer, and determine whether the requested service can be provided without degrading the service to other bearers, taking into account the transmission power of the requested bearer. If the new bearer can be serviced without harming other bearers, the request is admitted. Admission control typically co-operates with power control, whereby the transmission power of some of the other bearers may be adjusted in order to guarantee the SIR target level of the other bearers.

Various admission control algorithms have been proposed in the past. The article "SIR-Based Call Admission Control for DS-CDMA Cellular Systems" by Zhao Liu and Magda El Zarki, I2 Journal on selected areas in communications, vol. 12, no. 4, pp. 638-644, May 1994, describes an algorithm based on the concept of residual capacity. Residual capacity is defined as the additional number of initial calls a base station can accept. If the residual capacity is larger than zero, new calls are admitted. The residual capacity is determined from measured SIR levels and a threshold SIR level.

Another algorithms are described in the article "Call Admission in Power Controlled CDMA Systems" by Ching Yao Huang and Roy D. Yates, in proceedings of I2 VTS 46th Vehicular Technology Conference, April 28 - May 1, 1996, Atlanta, USA, pp. 1665-1669. In this article, two simple algorithms are presented. In the first algorithm, a new call is blocked when that new call would cause ongoing calls to transmit at maximum power. In the second algorithm, a new call is blocked if the total received power measured at the base station exceeds a predetermined threshold.

These algorithms function well, when the calls i.e. bearers are relatively similar in terms of resource usage, and any admission thresholds are set to a level where the admission of a bearer does not increase the load too near to the maximum capacity. However, these algorithms do not function well, when the bearers have widely varying properties, i.e. when the network needs to handle both low bit rate bearers

such as normal speech bearers, and high bit rate bearers such as high-capacity data bearers or live video bearers. Such a variety of services will be provided for example by the UMTS cellular telecommunication system presently under development. For example, in the conventional algorithm in which a new call is allowed if the total received power measured at the base station is under a predetermined threshold, a high bit rate bearer may increase the network load too near to the maximum capacity. This can be prevented by lowering the threshold so that any high rate bearers allowed close to the threshold still do not increase the total load too much, but in that case, the low bit rate speech bearers end up being refused even if the remaining capacity could accommodate them.

The problem with the known admission control methods is, that they consider all bearers to have an evenly distributed bit rate usage, without regarding the differing properties of different bearers. This presents a problem in a situation, where there are bearers with widely differing characteristics within a control region, for example a large number of voice calls and a few real time video connections. A problem with high bit rate bearers is that even though the received total power in their control region is quite satisfactory, that control region may cause too much interference to some neighbouring control region because of the unequal distribution of the interfering power within it.

The document US-A-5 497 504 (Acampora et al.) describes an admission control method where a request for a connection of a certain type is first tested by checking the number of already existing connections of the same type. If that test succeeds, the request is also tested to see, whether it conforms to certain local policies. The document US-A-5 666 348 (Thornberg et al.) describes a method for handling requests for packet channel capacity. A request contains a priority value and an indicator for the estimated data traffic. The admission control algorithm considers existing packet calls that have at least as high a priority value, and admits the request if a certain sum of estimated data traffic does not exceed a maximum value.

SUMMARY OF THE INVENTION

An object of the invention is to realize an admission control method, which takes into account differences between the resource usage of different bearers. A further object of the invention is to realize an admission control method, which provides efficient and widely adjustable control over admission of both bearers using small amounts of resources and bearers using large amounts of resources.

The objects are reached by a two-part admission control method, in which a test of a first kind monitors all bearers in roughly the same way, and in which a test of a second kind monitors specifically bearers using large amounts of resources.

The method according to the invention is characterized by that, which is specified in the characterizing part of the independent method claim. The network element according to the invention is characterized by that, which is specified in the characterizing part of the independent claim directed to a network element. The dependent claims describe further advantageous embodiments of the invention.

In a method according to the invention, a bearer request is checked with two different tests before it is admitted or rejected. A test of a first kind is used for overall control, i.e. all bearers are treated in a roughly similar way. A test of a second kind is used for controlling bearers, which present a high load to the network. A bearer request must then pass a combination of a test of the first kind and a test of the second kind in order to be admitted. A two-part test according to the invention is able to efficiently handle both even and skewed traffic.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail in the following with reference to the accompanying drawings, of which

Figure 1 illustrates a method according to an advantageous embodiment of the invention,

Figure 2 illustrates a method according to another advantageous embodiment of the invention,

Figure 3 illustrates an example of a test of the first kind according to an advantageous embodiment of the invention,

Figure 4 illustrates another example of a test of the first kind according to an advantageous embodiment of the invention,

Figure 5 illustrates an example of a test of the second kind according to an advantageous embodiment of the invention,

Figure 6 illustrates an example of a load curve used in some embodiments of the invention, and

Figure 7 illustrates further advantageous embodiments of the invention.

Same reference numerals are used for similar entities in the figures.

DETAILED DESCRIPTION

First, let us define some terms. In the following specification, non-controllable traffic means that part of the traffic in a cellular telecommunications system, which the network is required to transmit. Non-controllable traffic comprises real time (RT) bearers and the traffic caused by the minimum bit rate requirement of non-real-time (NRT) bearers. Controllable traffic comprises such traffic, which the network may transmit or whose transmission the network may delay according to available capacity. Controllable traffic comprises mainly the part of the traffic caused by NRT bearers, which is above the minimum required bit rate. Preferably, non-controllable traffic is used as a basis of predictions since controllable load can be adjusted according to changing new situations. In the following specification, the term control region means a cell, a sector of a cell or any other area under active power and admission control by a single entity. Typically, a control region comprises a single cell, or in the case of sectored cells, a single sector of a cell. The term own control region refers to the control region under control of a controlling entity, i.e. the control region being controlled by a method according to the invention.

A method according to the invention comprises a two-part admission control test, which the bearer must pass in order to be admitted. The two parts comprise a test of a first kind, which treats the bearers in a similar way without regard to differences in resource usage between bearers, and a test of a second kind, which concentrates on bearers consuming a large amount of air interface resources.

The two tests of the two-part test according to the invention can be combined in more than one way. According to an advantageous embodiment described with the help of figure 1, the requested bearer must pass separately each of the two tests. According to a further advantageous embodiment described with the help of figure 2, the results of a test of the second kind are used to adjust the admission criteria of a test of the first kind, which the requested bearer must pass in order to be admitted. In other words, in some embodiments of the invention a test of the second kind does not directly decide whether a requested bearer is admitted or not, but affects the admission decision indirectly by adjusting the admission requirements of a test of the first kind.

Figure 1 illustrates a method according to an advantageous embodiment of the invention. This embodiment illustrates the functioning of a two-part admission control test applied to a bearer request received by a cellular telecommunications network. First, it is checked 305 whether the bearer request is admissible according to a test of the first kind. If the bearer request is not admissible, then the request is refused 320 and the test is ended 325. If the bearer request was found to be admissible according to a test of the first kind, it is checked in the next step 310 whether the bearer request is admissible according to a test of the second kind. If the bearer request is not admissible, then the request is refused 320 and the test is ended 325. If the bearer request is admissible, then the bearer is admitted 315 and the test is ended 325.

Figure 2 illustrates a method according to a further advantageous embodiment of the invention. This embodiment illustrates the functioning of a two-part admission control test applied to a bearer request received by a cellular telecommunications network. First, it is checked 405 whether the bearer request satisfies a test of the second kind. If the bearer request satisfies the test, the method is continued at step 415. If the bearer request does not satisfy the test, admission criteria of the test of the first kind is changed 410, after which the method is continued at step 415. At step 415, it is checked whether the bearer request is admissible according to the test of the first kind. If the bearer request is not admissible, then the request is refused 420 and the test is ended 430. If the bearer request is admissible, then the bearer is admitted 425 and the test is ended 430.

In the following, examples of tests of the first kind are described, after which examples of tests of the second kind are described.

A. Examples of tests of the first kind

A.1. First example of a test of the first kind

In this example, the load is defined as the total power received by the receiver of the controlling entity in the control region, such as the receiver of the base station of a cell. For the purposes of admission control, the load due to non-controllable traffic is observed:

$$Load\_UL = Prx\_dBm_{current} = 10 \cdot \log_{10}(Prx_{inura,nc}) \quad (1)$$

where $Prx_{intra,nc}$ is total received power of non-controllable traffic in the own control region. When a request to set up a new bearer is made, it is checked whether the

load remains under a predetermined threshold, if the requested bearer is admitted. This can be performed by forming an estimate Prx_dBm_{pred} of the received power in the case the requested bearer is admitted:

$$Prx\_dBm_{pred} = Prx\_dBm_{current} + Prx\_dB_{inc} \quad (2)$$

where Prx_dB_{inc} is the estimated increase in the received power due to the new bearer. The estimate Prx_dBm_{pred} of the received power is compared to a threshold Prx_dBm_{th}, and if the following inequality holds

$$Prx\_dBm_{pred} < Prx\_dBm_{th} \quad (3)$$

the bearer is admitted. The received power of the new bearer i.e. the estimated increase Prx_dB_{inc} in the received power due to the new bearer depends on the bit rate and SIR target level of the bearer. A coefficient k from the load curve can be used to estimate the received power Prx_dB_{inc} in the following way:

$$Prx\_dB_{inc} = k \cdot \frac{SIR_{target}}{PG} \quad (4)$$

where PG is the processing gain. Obtaining of coefficient k is described in detail later in this specification.

Although equation (1) describes the calculations using dBm values, the invention is not limited to using dBm values. Therefore, the equations recited in this specification are only examples of feasible calculation methods, and do not limit the embodiments of the invention.

A.2. Second example of a test of the first kind

The previous example can be enhanced by taking into account the effect of at least some of the neighboring control regions. This can be effected by introducing a neighboring control region term into the previous equations. The neighboring control region term preferably comprises both controllable and non-controllable traffic, since from the point of view of the own control region being controlled, neither of them can be changed. The predicted load in the considered control region i can be calculated with the equations

$$Prx\_dBm_{current,i} = 10 \cdot log_{10}(Prx_{intra,nc,i} + Prx_{other,all,i}) \quad (5)$$

$$Prx\_dBm_{total,pred,i} = Prx\_dBm_{current,i} + Prx\_dB_{inc} \quad (6)$$

where $Prx_{intra,nc,i}$ is the received power in the own control region due to non-controllable traffic in the region and $Prx_{other,all,i}$ is the received power in the control region due to traffic in other control regions. The term Prx_dB_{inc} in equation (6) can be estimated using equation (4). When using equations (5) and (6), the admission condition can be stated in the following way:

$$Prx\_dBm_{total,pred,i} < Prx\_dBm_{th} \quad (7)$$

A.3. Third example of a test of the first kind

In a further advantageous embodiment of the invention, statistical properties of different bearers are taken into account. A requested bearer is not taken into account as a single bit rate value, but rather as a distribution of bit rates.

First, a distribution of bit rates is created for at least some services i.e. bearer types. This may be performed for example by observing, how much of the time a certain bearer uses a certain bit rate, and repeating this observation for all bit rates used by the bearer. The bit rate distribution of a service does not usually change very quickly, wherefore distributions need not be collected very often.

In the following step, the distributions of existing bearers are convoluted to obtain the combined distribution of already existing bearers.

As an example of convolution of two distributions, let us consider the case of a speech and a video bearer. In this example, we assume that the speech bearer has a data rate of 0 kbit/s half of the time and 16 kbit/s for the other half of the time, i.e. both rates having the same probability of 0.5. Let us also assume that the video bearer has the following data rates and associated probabilities:

rate (kbit/s)	64	128	192	256	320	384
probability	0.1	0.3	0.1	0.3	0.1	0.1

When these two distributions are convoluted, we obtain the following combined distribution:

rate (kbit/s)	64	80	128	144	192	208	256	272	320	336	384	400
probability	0.05	0.05	0.15	0.15	0.05	0.05	0.15	0.15	0.05	0.05	0.05	0.05

Any number of distributions may be combined by convolution in this way. Since convolution is a common mathemathical tool and known by the man skilled in the art, calculation of convolutions is not described in further detail here.

As in some of the previously described embodiments, the transmissions from at least some of the neighbouring control regions may be taken into consideration. These transmissions can advantageously be represented by a predefined default distribution in the calculation of the convolutions, which predefined default distribution can be scaled before the convolution operation in order to match the observed interference level. Noise parameters may also conveniently be included in the calculations in a similar way as the transmission from neighbouring control regions.

However, in some embodiments of the invention according to the third example of a test of the first kind, the effect of the other control regions may be left out of consideration in order to simplify the calculations.

In the following step, a distribution for the requested bearer is determined. This is advantageously performed by selecting from a predefined library of distributions, one distribution which corresponds most closely to the properties of the requested bearer. The predefined library may comprise one, two or more predefined distributions. Preferably, the library comprises several predefined distributions corresponding to most typical bearer types.

The distribution for the requested bearer may also be obtained by scaling a default distribution to match the requested bearer properties, in which case a single default distribution may be used for all cases, or a default distribution may be chosen from a library of default distributions.

In a further advantageous embodiment of the invention, the distribution of the requested bearer is obtained by interpolation from two library distributions, or by combining several library distributions.

After determination of the distribution of the requested bearer, the distribution is convoluted with the distribution of already existing bearers for obtaining a predicted distribution.

In the following step, it is checked if the predicted distribution is within the required limits. This may be performed in many different ways, depending on how the limits are specified and how a distribution of values can be determined to be within the limit or limits. For example, the checking may be effected in one of the following ways a) to d).

a) A cumulative sum of the predicted distribution is calculated, beginning from the lowest bit rate values. Cumulative sum is calculated until a certain predefined value is exceeded. The rate at which the predefined value is exceeded, is compared to a threshold value. If the rate is lower than the threshold, the bearer passes this test.

b) The predicted distribution is weighted by a constant multiplier or by a weighting distribution before calculation of the cumulative sum and comparing as in a).

c) The predicted distribution is processed in some other way, for example a predefined function may calculate a value which is compared to a threshold value. Different bit rates can be weighted differently by construction of the predefined function. The admission control can be adjusted in many ways by choosing a suitable predefined function for obtaining the intended purpose: for example, to prefer low bit rate bearers or to prefer high bit rate bearers, or give preference to bearers having a bit rate within a specified bit rate range in order to guarantee better service to a certain service or a group of services. The function may also be constructed in such a way as to produce such admission control criteria, that all bearers are given equal preference regardless of their resource usage.

d) The threshold can be expressed as a distribution, which is directly compared with the predicted distribution. For example, the bearer can be refused, if the predicted distribution is higher than the threshold distribution at some load value.

Such embodiments of the invention which consider the existing bearers as distributions have the additional advantage, that a temporary deviation of the bit rate of a bearer from the nominal value does not affect the determination of the load. For example, if the load presented by a bearer is determined at any single instant, it might not represent the average load the bearer presents. This problem can be

avoided by expressing the load presented by a bearer as a distribution, which represents the actual load more accurately than a single measurement.

Figure 3 illustrates a test according to the third example of a test of the first kind. First, the combined distribution of existing bearers is determined in step 110. The combined distribution may be determined for example by any of the previously described ways. In the next step 115, the distribution of the requested bearer is determined for example by selecting a distribution from a set of predefined distributions, which distribution has properties corresponding to the properties of the requested bearer. In the next step 120, the distribution of the requested bearer is combined with the distribution of all bearers to form a predicted distribution. If the predicted distribution is found to be outside the admission limits in step 125, the request is refused in step 130 and the test is ended 140. If the predicted distribution is found to be within the admission limits in step 125, the bearer passes 135 this test and the test is ended 140.

A.4. Fourth example of a test of the first kind

In a further advantageous embodiment of the invention, the transmission power is taken into account when determining the load distributions. This gives a better representation of the actual load situation than only bit rate based distributions. The transmission power can be taken into account in several different ways, for example in one of the following ways:

- A distribution may represent the distribution of the received power of a bearer.
- A distribution may represent the distribution of received energy per bit of a bearer.
- A distribution may represent the distribution of the bit rate of the bearer, weighted by the average energy per bit value of a bearer.
- A distribution may represent the distribution of the bit rate of the bearer, weighted by the average energy per bit value of a bearer.
- A distribution may represent the distribution of the bit rate of a bearer, weighted with the probability distribution of the received power of the bearer.

However, the invention is not limited to only these examples of ways of constructing distributions indicating at least in part a measure of transmitted energy.

Since the energy per bit values may be difficult to determine, an estimate of the average energy per bit value may be obtained for example from an estimate of the average transmission power of the bearer and the average bit rate of the bearer.

In other respects, the embodiments according to the fourth example of a test of the first kind may use the methods described previously with bit rate distributions according to the third example of a test of the first kind, by replacing the bit rate distributions with distributions according to the fourth example of a test of the first kind.

A.5. Fifth example of a test of the first kind

The previously described third and fourth examples of a test of the first kind are computationally relatively intensive. To reduce the amount of calculations needed, the bearers can be treated in bearer groups to simplify the formation of the combined distribution of existing bearers. A bearer group is preferably a group of bearers having roughly similar BER requirement, i.e. roughly the same received energy per bit requirement. The bearers can also be grouped on the basis of the shape of their distributions.

The combined distribution of existing bearers can be determined for example as follows. First, the existing bearers are grouped to one or more bearer groups. Then, a distribution is determined for each group, preferably by selecting a distribution from a library of predefined distributions. Alternatively, certain bearer group types can be predefined, each with an associated predefined distribution. The distribution of each group is scaled to represent the total load represented by all of the bearers of the group. In the next step, the scaled group distributions are combined to form the combined distribution of existing bearers, preferably by convolving the distributions as described previously.

Next, the distribution of the requested bearer is determined. After that step, the predicted probability distribution is determined, which is preferably performed by combining the distribution of the requested bearer with the combined distribution of existing bearers.

Testing of whether the predicted distribution is within admission limits can be performed as described previously in the third example of a test of the first kind.

In a further embodiment according to the fifth example of a test of the first kind, the requested bearer is taken into account already before the combining of the group distributions. In such an embodiment, the requested bearer is taken into account by an additional scaling of the distribution of that bearer group, which most closely corresponds to the requested bearer. As a consequence, the result of the combining of group distributions is directly the predicted distribution.

Figure 4 illustrates a test according to the fifth example of a test of the first kind. In this example of an embodiment of the invention, the existing bearers are first grouped in bearer groups in step 205. In the next step 210, the distributions of the bearer groups are determined for example by selecting from a set of predefined distributions, after which each distribution is scaled in step 215 to match the load presented by the corresponding group of bearers. The scaled group distributions are combined in step 220 to obtain a combined distribution of existing bearers. In the next step 225, the distribution of the requested bearer is determined for example by selecting a distribution from a set of predefined distributions, which distribution has properties corresponding to the properties of the requested bearer. In the next step 230, the distribution of the requested bearer is combined with the distribution of all bearers to form a predicted distribution. If the predicted distribution is found to be outside the admission limits in step 235, the request is refused in step 240 and the test is ended 250. If the predicted distribution is found to be within the admission limits in step 235, the bearer passes 245 this test and the test is ended 250.

B. Examples of tests of the second kind

The tests of the second kind concentrate on bearers, which require relatively large amounts of resources. Such bearers are denoted in the following by the term high load (HL) bearer. A bearer may be a HL bearer for example if the bit rate of the bearer is high, if the transmission power of the bearer is high, or the energy per transmitted bit E_b is high. The thresholds determining if a bearer is a normal i.e. a low load bearer or a high load bearer may be defined in many different ways according to the needs of the particular implementation of the invention, and the invention is not limited to any specific such threshold or way of determining whether a bearer is a HL bearer or not.

Since the bit rate of a bearer is straightforward to monitor, the bit rate can advantageously be used for determining whether a bearer is a normal or a HL bearer. The bit rate threshold for the determination can be adjusted for example by

experimenting with different values of the threshold and choosing the value producing the optimum performance of the network. The bit rate threshold may be different in different control regions. Further, in some embodiments of the invention the network may adjust the bit rate threshold in a control region according to the traffic situation.

In the following examples of tests of the second kind, the first four present tests of the second kind, which can be used in a method according to figure 1, and the rest present tests of the second kind, which can be used in a method according to figure 2.

B.1. First example of a test of the second kind

According to a further advantageous embodiment of the invention, problems created by a skewed load is alleviated by preventing the admission of too many high load bearers to one control region. The admission or rejection of HL bearers is in an advantageous embodiment of the invention performed simply on the basis of the number of HL bearers already active in a control region. A new bearer passes this test if the following inequality holds:

$$HL_i + HL_{new} \leq HL_{thl} \qquad (8)$$

where

HL_i is the number of existing HL bearer in the control region i

HL_{new} is 1 if the new bearer is a HL bearer, otherwise 0, and

HL_{thl} is the predetermined maximum number of HL bearers in one control region.

The addition of 1 in equation (8) is not essential in various embodiments of the invention according to the first example of a test of the second kind. The test may simply be a comparison of HL_i to a threshold, in which case only HL bearers are required to pass this comparison.

B.2. Second example of a test of the second kind

In a further advantageous embodiment of the invention, the previously described first example of a test of the second kind is enhanced by taking the neighbouring control regions into account as well. In such an embodiment, the admission condition can be for example the following:

$$\sum_{i=1}^{nearbyBSs} HL_i + HL_{new} \leq HL_{th2} \qquad (9)$$

where HL_{th2} is the maximum number of HL bearers within the own control region and the considered neighbouring control regions. The sum is calculated over a desired number of nearby control regions, for example all directly neighbouring control regions.

Figure 5 illustrates a test according to the first or the second example of a test of the second kind. In figure 5, the existing high load bearers are counted in step 260. The counting may be done over the own control region as in the first example of a test of the second kind, or for example over the directly neighbouring control regions as in the second example of a test of the second kind. In the next step 265, the result is incremented by one, if the requested bearer is a high load bearer. In the next step 270 the result is compared to a predefined threshold value. If the result is larger than the threshold, the request is refused in step 280 and the test is ended. If the result is smaller than or equal to the threshold, the bearer is determined to pass 275 this test and the test is ended 285.

B.3. Third example of a test of the second kind

In a further advantageous embodiment of the invention, instead of the number of HL bearers as in equations (8) and (9), the admission condition can be based on the sum of bit rates of HL bearers in a control region or a group of control regions. This sum is then compared to a predefined threshold sum. If the predefined threshold sum is smaller than the sum of bit rates, the requested bearer is refused.

In a still further advantageous embodiment of the invention, the admission condition is based on the sum of bit rates of HL bearers as a percentage of total combined bit rate of all bearers within a control region or a group of control regions. This percentage sum is then compared to a predefined threshold percentage value. If the threshold value is smaller than the sum, the requested bearer is refused.

B.4. Fourth example of a test of the second kind

In a further advantageous embodiment of the invention, the admission condition can be based on the sum of transmission power of existing HL bearers in a control

region or a group of control regions. The sum is compared to a predefined threshold value, and if the threshold value is smaller than the sum, the requested bearer is refused.

B.5. Fifth example of a test of the second kind

In a further advantageous embodiment of the invention, the result of a test of the second kind is used to control the admission threshold used in a test of the first kind. This may be effected in many different ways, examples of which are presented in the following.

- For example, the admission threshold may be changed by a predefined amount if one or more HL bearers already exist.
- For example, the admission threshold may be changed by a predefined amount once for each HL bearer already existing.
- For example, the sum of bit rates of HL bearers may be computed and the sum compared to a predefined maximum value, and the admission threshold may be changed according to the ratio of the sum to the predefined maximum value.
- For example, the total transmission power of HL bearers may be determined and compared to a predetermined maximum value, and the admission threshold may be changed according to the ratio of the total transmission power and the predetermined maximum value.

However, the invention is not limited to these examples of ways, in which the admission threshold used in a test of the first kind can be changed according to the result of a test of the second kind. Other ways may be used in various embodiments of the invention. For example, in some embodiments of the invention the HL bearers in neighbouring control regions are taken into account.

B.6. Sixth example of a test of the second kind

In those embodiments of the invention, in which bearers are processed as distributions and a predicted distribution is obtained in the test of the first kind, the admission control adjustment may be effected in a wide variety of ways depending on how the predicted distribution is determined to be within admission criteria or outside the admission criteria. In such an embodiment the admission criteria can be adjusted uniformly for all bearers, or adjusted to be stricter to certain bearer types

only. For example, the admission criteria can be adjusted to be stricter for new HL bearers while retaining the previous admission criteria for normal bearers.

Further, instead of adjusting the predefined admission limits, the processing of the predicted distribution can be adjusted for effecting the desired changes in admission requirements. For example, the predicted distribution can be weighted with a suitable distribution emphasizing the high bit rate values, which results in less resources being available to high load bearers. Further, if a predefined function calculates a value based on the predicted distribution, and this value is then compared to a predefined threshold for obtaining the admission decision, the function can be changed for effecting the desired changes in admission requirements.

C. Further considerations

In various embodiments described previously, the estimated increase Prx_dB_{inc} in received power due to a new bearer is estimated with the help of a load curve. A load curve can be obtained as follows. It is generally known that SIR value SIR_i of a bearer i may be calculated as

$$SIR_i = PG_i \cdot \frac{Prx_i}{\sum_{\substack{j=1 \\ j \neq i}}^{N} Prx_j + P_a} \tag{10}$$

where PG_i is the processing gain of the bearer, Prx_i is the received power of the bearer i, the sum in the denominator is performed over the received power of other bearers, and the term P_a denotes other interference sources and noise. From this follows

$$\frac{SIR_i}{PG_i} = \frac{Prx_i}{\sum_{\substack{j=1 \\ j \neq i}}^{N} Prx_j + P_a} \tag{11}$$

Summing SIR_i / PG_i over many bearers and allowing the number of bearers go to infinity, we obtain the limit

$$\sum_{i=1}^{N} \frac{SIR_i}{PG_i} \xrightarrow[N\to\infty]{} 1 \qquad (12)$$

A load curve can be obtained by plotting $\sum Prx_i$ as a function of $\sum (SIR_i / PG_i)$. An example of a load curve is given in figure 6. The load curve has an roughly linear portion in the middle. The coefficient k mentioned previously can be obtained from the load curve as the slope of a part of the roughly linear portion of the load curve. The coefficient k can also be found out by measuring the received total power level, i.e. $\sum Prx_i$, at different traffic situations with different numbers of active bearers i.e. at different values of $\sum (SIR_i / PG_i)$, and fitting a straight line into the measurement data. The slope of the line may then be used as the coefficient k.

The method according to the invention can be used as well in bearer negotiations i.e. if a first bearer request does not pass, a second bearer request with different parameters can be examined and so on, until admissible bearer parameters are found.

The method according to the invention can advantageously be used in a radio network controller (RNC) or other cellular telecommunications network element performing admission control. The method according to the invention can advantageously be applied in the UMTS cellular telecommunication system and other telecommunications systems at least partly based on the CDMA technology. The name of a given functional entity, such as the radio network controller, is often different in the context of different cellular telecommunication systems. For example, in the GSM system the functional entity corresponding to a radio network controller (RNC) is the base station controller (BSC).

D. Further embodiments of the invention

According to an advantageous embodiment, means for realizing the inventive method are incorporated in a network element of a telecommunications network. One example of such a network element is the radio network controller of a cellular telecommunications network. Figure 7 illustrates one example of such an embodiment. Figure 7 shows mobile stations 505 which are in radio connection with base stations 510. The base stations are connected to and controlled by a radio network controller 520, which is in turn connected to rest of the cellular telecommunications network 550. The cellular telecommunications network may,

for example, be the UMTS cellular telecommunications network presently under development. According to this embodiment, the radio network controller comprises means 521, 522, 523 for testing a bearer request according to a test of a first kind and for producing a first test result, means 521, 522, 524 for testing a bearer request according to a test of a second kind and producing a second test result, and means 521, 522, 525 for deciding about admission of the bearer on the basis of said first and second test result. These means may be for example, a processing unit 521 such as a microprocessor 521 or a digital signal processor 521, a memory unit 522 comprising programs 523, 524, 525 executed by the processing unit 521 for performing the test of the first kind and test of the second kind and producing the admission or rejection decision based on the results of the tests for example according to the examples of methods recited previously.

The threshold values of admission conditions do not need to be permanently fixed values. The threshold values may be adjusted by the controlling entity of the control region or another element of the cellular telecommunications network in various embodiments of the invention, for example to optimize the resource usage of the network.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications and variations may be made to the above-presented exemplary embodiments of the invention.

Claims

1. An admission control method for handling bearer requests in a cellular telecommunications network that supports bearers that are allowed to comprise controllable load components in addition to non-controllable traffic load components,
characterized in that it comprises sequentially the steps of:
- testing a bearer request with a test of a first kind (305, 415) that sets criteria for non-controllable traffic load components in an essentially similar way for all bearer requests, and
- said bearer request is tested with a test of a second kind (310, 405);
wherein said test of a second kind (310, 405) monitors bearers that present to the network a non-controllable load component which exceeds a predefined threshold, and the admission (315, 420) of said bearer request depends on the results of both said test of a first kind (305, 415) and said test of a second kind (310, 405).

2. Admission control method according to claim 1, **characterized** in that said test of a first kind (305, 415) is based on statistical properties (110, 115, 120) of bearers.

3. Admission control method according to claim 1, **characterized** in that in said test of a second kind (310, 405) the number (260, 265) of currently existing high load bearers is compared (270) to a predefined threshold.

4. Admission control method according to claim 1, **characterized** in that in said test of a second kind (310, 405) the sum of bit rates of currently existing high load bearers and of the requested bearer is compared to a predefined threshold.

5. Admission control method according to claim 1, **characterized** in that the admission criteria of said test of a first kind (415) are changed (410) according to the results of said test of a second kind (405).

6. Admission control method according to claim 5, **characterized** in that an admission threshold of said test of a first kind (305, 415) is changed by a predefined step, if at least one high load bearer exists already.

7. Admission control method according to claim 6, **characterized** in that an admission threshold of said test of a first kind (305, 415) is changed by a second predefined step for each high load bearer existing already.

8. Network element (520) for a cellular telecommunications network that supports bearers that are allowed to comprise controllable load components in addition to non-controllable traffic load components, **characterized** in that the element comprises

- means (521, 522, 523) for testing a bearer request according to a test of a first kind that sets criteria for non-controllable traffic load components in an essentially similar way for all bearer requests, and for producing a first test result,
- means (521, 522, 524) for testing a bearer request, sequentially with said test of a first kind, according to a test of a second kind that monitors bearers that present to the network a non-controllable load component which exceeds a predefined threshold, and producing a second test result, and
- means (521, 522, 525) for deciding about admission of the bearer on the basis of said first and second test results.

9. Network element (520) for a cellular telecommunications network according to claim 8, **characterized** in that the network element is a radio network controller.

Abstract

The invention is related to radio resource usage in cellular telecommunication systems, more accurately to admission control methods used in establishing of new connections. In a method according to the invention, a bearer request is checked with two different tests before it is admitted or rejected. A test of a first kind is used for overall control, i.e. all bearers are treated in a roughly similar way. A test of a second kind is used for controlling bearers, which present a high load to the network. A bearer request must then pass a combination of a test of the first kind and a test of the second kind in order to be admitted. A two-part test according to the invention is able to efficiently handle both even and skewed traffic.

Figure 1

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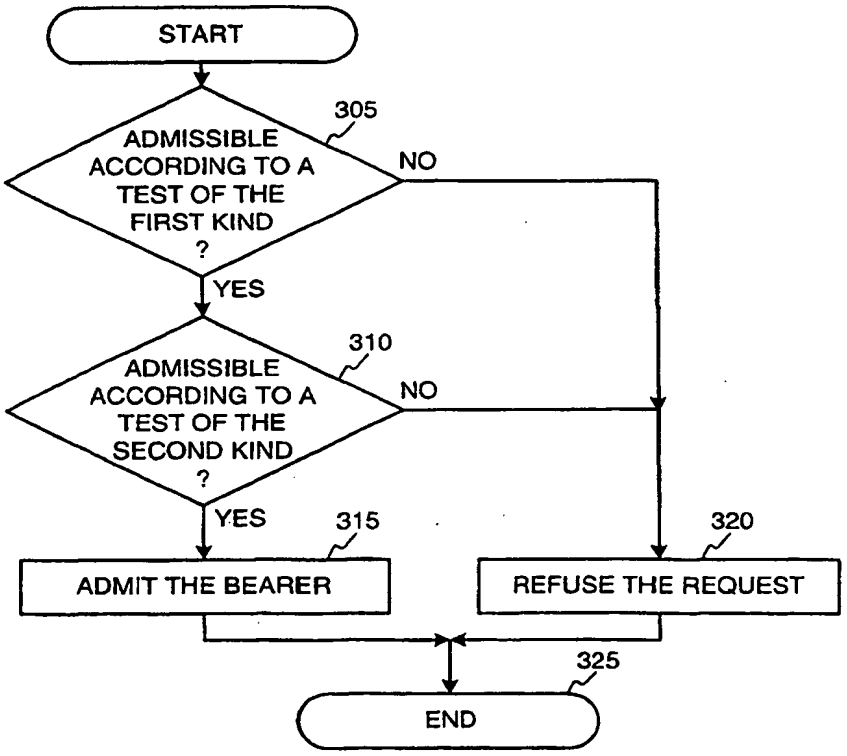
(57) Abstract

The invention is related to radio resource usage in cellular telecommunication systems, more accurately to admission control methods used in establishing of new connections. In a method according to the invention, a bearer request is checked with two different tests before it is admitted or rejected. A test of a first kind is used for overall control, i.e. all bearers are treated in a roughly similar way. A test of a second kind is used for controlling bearers, which present a high load to the network. A bearer request must then pass a combination of a test of the first kind and a test of the second kind in order to be admitted. A two–part test according to the invention is able to efficiently handle both even and skewed traffic.



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Admission control method

TECHNICAL FIELD OF THE INVENTION

The invention is related to radio resource usage in cellular telecommunication systems, more accurately to admission control methods used in establishing of new connections.

BACKGROUND OF THE INVENTION

In cellular telecommunication systems a single speech connection or data connection through the cellular telecommunication network is called a bearer. Generally, a bearer is associated with a set of parameters pertaining to data communication between a certain terminal equipment and a network element, such as a base station or an interworking unit (IWU) connecting the cellular network to another telecommunications network. The set of parameters associated with a bearer comprises typically for example data transmission speed, allowed delays, allowed bit error rate (BER), and the minimum and maximum values for these parameters. A bearer may further be a packet transmission bearer or a circuit switched bearer and support for example transparent or non-transparent connections. A bearer can be thought of as a data transmission path having the specified parameters connecting a certain mobile terminal and a certain network element for transmission of payload information. One bearer always connects only one mobile terminal to one network element. However, a bearer can pass through a number of network elements. One mobile communication means (ME, Mobile Equipment) may in some cellular telecommunication systems support one bearer only, in some other systems also more than one simultaneous bearers.

In order to be able to transmit information in a desired way, connections over the radio interface have to obtain a desired level of quality. The quality can be expressed for example as the C/I i.e. Carrier to Interference ratio, which indicates the ratio of received carrier wave power to received interfering power. Other measures for the quality of a connection are SIR i.e. Signal to Interference ratio, S/N i.e. Signal to Noise ratio, and S/(I+N) i.e. Signal to Noise plus Interference ratio. The bit error rate (BER) or frame error rate (FER) are also used as measures of connection quality. Typically, a certain target level for one of these or other corresponding measures is determined beforehand, and for each connection, the

transmission power is adjusted to be such that the target level is reached as closely as possible. The transmission power should not be higher than what is necessary for obtaining the desired target level, since a too high transmission level wastes electrical energy in the transmitting equipment, which is crucial with handheld mobile stations, and causes interference to other connections.

Admission control is a crucial function in ensuring, that each bearer obtains the desired SIR level. The purpose of admission control is to examine each new request for a new bearer, and determine whether the requested service can be provided without degrading the service to other bearers, taking into account the transmission power of the requested bearer. If the new bearer can be serviced without harming other bearers, the request is admitted. Admission control typically co-operates with power control, whereby the transmission power of some of the other bearers may be adjusted in order to guarantee the SIR target level of the other bearers.

Various admission control algorithms have been proposed in the past. The article "SIR-Based Call Admission Control for DS-CDMA Cellular Systems" by Zhao Liu and Magda El Zarki, I2 Journal on selected areas in communications, vol. 12, no. 4, pp. 638-644, May 1994, describes an algorithm based on the concept of residual capacity. Residual capacity is defined as the additional number of initial calls a base station can accept. If the residual capacity is larger than zero, new calls are admitted. The residual capacity is determined from measured SIR levels and a treshold SIR level.

Another algorithms are described in the article "Call Admission in Power Controlled CDMA Systems" by Ching Yao Huang and Roy D. Yates, in proceedings of I2 VTS 46th Vehicular Technology Conference, April 28 - May 1, 1996, Atlanta, USA, pp. 1665-1669. In this article, two simple algorithms are presented. In the first algorithm, a new call is blocked when that new call would cause ongoing calls to transmit at maximum power. In the second algorithm, a new call is blocked if the total received power measured at the base station exceeds a predetermined treshold.

These algorithms function well, when the calls i.e. bearers are relatively similar in terms of resource usage, and any admission tresholds are set to a level where the admission of a bearer does not increase the load too near to the maximum capacity. However, these algorithms do not function well, when the bearers have widely varying properties, i.e. when the network needs to handle both low bit rate bearers such as normal speech bearers, and high bit rate bearers such as high-capacity data

bearers or live video bearers. Such a variety of services will be provided for example by the UMTS cellular telecommunication system presently under development. For example, in the conventional algorithm in which a new call is allowed if the total received power measured at the base station is under a predetermined treshold, a high bit rate bearer may increase the network load too near to the maximum capacity. This can be prevented by lowering the treshold so that any high rate bearers allowed close to the treshold still do not increase the total load too much, but in that case, the low bit rate speech bearers end up being refused even if the remaining capacity could accommodate them.

The problem with the known admission control methods is, that they consider all bearers to have an evenly distributed bit rate usage, without regarding the differing properties of different bearers. This presents a problem in a situation, where there are bearers with widely differing characteristics within a control region, for example a large number of voice calls and a few real time video connections. A problem with high bit rate bearers is that even though the received total power in their control region is quite satisfactory, that control region may cause too much interference to some neighbouring control region because of the unequal distribution of the interfering power within it.

SUMMARY OF THE INVENTION

An object of the invention is to realize an admission control method, which takes into account differences between the resource usage of different bearers. A further object of the invention is to realize an admission control method, which provides efficient and widely adjustable control over admission of both bearers using small amounts of resources and bearers using large amounts of bearers.

The objects are reached by a two-part admission control method, in which a test of a first kind monitors all bearers in roughly the same way, and in which a test of a second kind monitors specifically bearers using large amounts of resources.

The method according to the invention is characterized by that, which is specified in the characterizing part of the independent method claim. The network element according to the invention is characterized by that, which is specified in the characterizing part of the independent claim directed to a network element. The dependent claims describe further advantageous embodiments of the invention.

In a method according to the invention, a bearer request is checked with two different tests before it is admitted or rejected. A test of a first kind is used for overall control, i.e. all bearers are treated in a roughly similar way. A test of a second kind is used for controlling bearers, which present a high load to the network. A bearer request must then pass a combination of a test of the first kind and a test of the second kind in order to be admitted. A two-part test according to the invention is able to efficiently handle both even and skewed traffic.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail in the following with reference to the accompanying drawings, of which

Figure 1 illustrates a method according to an advantageous embodiment of the invention,

Figure 2 illustrates a method according to another advantageous embodiment of the invention,

Figure 3 illustrates an example of a test of the first kind according to an advantageous embodiment of the invention,

Figure 4 illustrates another example of a test of the first kind according to an advantageous embodiment of the invention,

Figure 5 illustrates an example of a test of the second kind according to an advantageous embodiment of the invention,

Figure 6 illustrates an example of a load curve used in some embodiments of the invention, and

Figure 7 illustrates further advantageous embodiments of the invention.

Same reference numerals are used for similar entities in the figures.

DETAILED DESCRIPTION

First, let us define some terms. In the following specification, non-controllable traffic means that part of the traffic in a cellular telecommunications system, which the network is required to transmit. Non-controllable traffic comprises real time (RT) bearers and the traffic caused by the minimum bit rate requirement of non-real-time (NRT) bearers. Controllable traffic comprises such traffic, which the network may transmit or whose transmission the network may delay according to available capacity. Controllable traffic comprises mainly the part of the traffic

caused by NRT bearers, which is above the minimum required bit rate. Preferably, non-controllable traffic is used as a basis of predictions since controllable load can be adjusted according to changing new situations. In the following specification, the term control region means a cell, a sector of a cell or any other area under active power and admission control by a single entity. Typically, a control region comprises a single cell, or in the case of sectored cells, a single sector of a cell. The term own control region refers to the control region under control of a controlling entity, i.e. the control region being controlled by a method according to the invention.

A method according to the invention comprises a two-part admission control test, which the bearer must pass in order to be admitted. The two parts comprise a test of a first kind, which treats the bearers in a similar way without regard to differences in resource usage between bearers, and a test of a second kind, which concentrates on bearers consuming a large amount of air interface resources.

The two tests of the two-part test according to the invention can be combined in more than one way. According to an advantageous embodiment described with the help of figure 1, the requested bearer must pass separately each of the two tests. According to a further advantageous embodiment described with the help of figure 2, the results of a test of the second kind are used to adjust the admission criteria of a test of the first kind, which the requested bearer must pass in order to be admitted. In other words, in some embodiments of the invention a test of the second kind does not directly decide whether a requested bearer is admitted or not, but affects the admission decision indirectly by adjusting the admission requirements of a test of the first kind.

Figure 1 illustrates a method according to an advantageous embodiment of the invention. This embodiment illustrates the functioning of a two-part admission control test applied to a bearer request received by a cellular telecommunications network. First, it is checked 305 whether the bearer request is admissible according to a test of the first kind. If the bearer request is not admissible, then the request is refused 320 and the test is ended 325. If the bearer request was found to be admissible according to a test of the first kind, it is checked in the next step 310 whether the bearer request is admissible according to a test of the second kind. If the bearer request is not admissible, then the request is refused 320 and the test is ended 325. If the bearer request is admissible, then the bearer is admitted 315 and the test is ended 325.

Figure 2 illustrates a method according to a further advantageous embodiment of the invention. This embodiment illustrates the functioning of a two-part admission control test applied to a bearer request received by a cellular telecommunications network. First, it is checked 405 whether the bearer request satisfies a test of the second kind. If the bearer request satisfies the test, the method is continued at step 415. If the bearer request does not satisfy the test, admission criteria of the test of the first kind is changed 410, after which the method is continued at step 415. At step 415, it is checked whether the bearer request is admissible according to the test of the first kind. If the bearer request is not admissible, then the request is refused 420 and the test is ended 430. If the bearer request is admissible, then the bearer is admitted 425 and the test is ended 430.

In the following, examples of tests of the first kind are described, after which examples of tests of the second kind are described.

A. Examples of tests of the first kind

A.1. First example of a test of the first kind

In this example, the load is defined as the total power received by the receiver of the controlling entity in the control region, such as the receiver of the base station of a cell. For the purposes of admission control, the load due to non-controllable traffic is observed:

$$Load\_UL = Prx\_dBm_{current} = 10 \cdot \log_{10}(Prx_{intra,nc}) \quad (1)$$

where $Prx_{intra,nc}$ is total received power of non-controllable traffic in the own control region. When a request to set up a new bearer is made, it is checked whether the load remains under a predetermined treshold, if the requested bearer is admitted. This can be performed by forming an estimate Prx_dBm_{pred} of the received power in the case the requested bearer is admitted:

$$Prx\_dBm_{pred} = Prx\_dBm_{current} + Prx\_dB_{inc} \quad (2)$$

where Prx_dB_{inc} is the estimated increase in the received power due to the new bearer. The estimate Prx_dBm_{pred} of the received power is compared to a treshold Prx_dBm_{th}, and if the following inequality holds

$$Prx\_dBm_{pred} < Prx\_dBm_{th} \quad (3)$$

the bearer is admitted. The received power of the new bearer i.e. the estimated increase Prx_dB_{inc} in the received power due to the new bearer depends on the bit rate and SIR target level of the bearer. A coefficient k from the load curve can be used to estimate the received power Prx_dB_{inc} in the following way:

$$Prx\_dB_{inc} = k \cdot \frac{SIR_{target}}{PG} \quad (4)$$

where PG is the processing gain. Obtaining of coefficient k is described in detail later in this specification.

Although equation (1) describes the calculations using dBm values, the invention is not limited to using dBm values. Therefore, the equations recited in this specification are only examples of feasible calculation methods, and do not limit the embodiments of the invention.

A.2. Second example of a test of the first kind

The previous example can be enhanced by taking into account the effect of at least some of the neighboring control regions. This can be effected by introducing a neighboring control region term into the previous equations. The neighboring control region term preferably comprises both controllable and non-controllable traffic, since from the point of view of the own control region being controlled, neither of them can be changed. The predicted load in the considered control region i can be calculated with the equations

$$Prx\_dBm_{current,i} = 10 \cdot log_{10}(Prx_{intra,nc,i} + Prx_{other,all,i}) \quad (5)$$

$$Prx\_dBm_{total,pred,i} = Prx\_dBm_{current,i} + Prx\_dB_{inc} \quad (6)$$

where $Prx_{intra,nc,i}$ is the received power in the own control region due to non-controllable traffic in the region and $Prx_{other,all,i}$ is the received power in the control region due to traffic in other control regions. The term Prx_dB_{inc} in equation (6) can be estimated using equation (4). When using equations (5) and (6), the admission condition can be stated in the following way:

$$Prx\_dBm_{total,pred,i} < Prx\_dBm_{th} \quad (7)$$

A.3. Third example of a test of the first kind

In a further advantageous embodiment of the invention, statistical properties of different bearers are taken into account. A requested bearer is not taken into account as a single bit rate value, but rather as a distribution of bit rates.

First, a distribution of bit rates is created for at least some services i.e. bearer types. This may be performed for example by observing, how much of the time a certain bearer uses a certain bit rate, and repeating this observation for all bit rates used by the bearer. The bit rate distribution of a service does not usually change very quickly, wherefore distributions need not be collected very often.

In the following step, the distributions of existing bearers are convoluted to obtain the combined distribution of already existing bearers.

As an example of convolution of two distributions, let us consider the case of a speech and a video bearer. In this example, we assume that the speech bearer has a data rate of 0 kbit/s half of the time and 16 kbit/s for the other half of the time, i.e. both rates having the same probability of 0.5. Let us also assume that the video bearer has the following data rates and associated probabilities:

rate (kbit/s)	64	128	192	256	320	384
probability	0.1	0.3	0.1	0.3	0.1	0.1

When these two distributions are convoluted, we obtain the following combined distribution:

rate (kbit/s)	64	80	128	144	192	208	256	272	320	336	384	400
probability	0.05	0.05	0.15	0.15	0.05	0.05	0.15	0.15	0.05	0.05	0.05	0.05

Any number of distributions may be combined by convolution in this way. Since convolution is a common mathemathical tool and known by the man skilled in the art, calculation of convolutions is not describer in further detail here.

As in some of the previously described embodiments, the transmissions from at least some of the neighbouring control regions may be taken into consideration. These transmissions can advantageously be represented by a predefined default distribution in the calculation of the convolutions, which predefined default

distribution can be scaled before the convolution operation in order to match the observed interference level. Noise parameters may also conveniently be included in the calculations in a similar way as the transmission from neighbouring control regions.

However, in some embodiments of the invention according to the third example of a test of the first kind, the effect of the other control regions may be left out of consideration in order to simplify the calculations.

In the following step, a distribution for the requested bearer is determined. This is advantageously performed by selecting from a predefined library of distributions, one distribution which corresponds most closely to the properties of the requested bearer. The predefined library may comprise one, two or more predefined distributions. Preferably, the library comprises several predefined distributions corresponding to most typical bearer types.

The distribution for the requested bearer may also be obtained by scaling a default distribution to match the requested bearer properties, in which case a single default distribution may be used for all cases, or a default distribution may be chosen from a library of default distributions.

In a further advantageous embodiment of the invention, the distribution of the requested bearer is obtained by interpolation from two library distributions, or by combining several library distributions.

After determination of the distribution of the requested bearer, the distribution is convoluted with the distribution of already existing bearers for obtaining a predicted distribution.

In the following step, it is checked if the predicted distribution is within the required limits. This may be performed in many different ways, depending on how the limits are specified and how a distribution of values can be determined to be within the limit or limits. For example, the checking may be effected in one of the following ways a) to d).

a) A cumulative sum of the predicted distribution is calculated, beginning from the lowest bit rate values. Cumulative sum is calculated until a certain predefined value

is exceeded. The rate at which the predefined value is exceeded, is compared to a treshold value. If the rate is lower than the treshold, the bearer passes this test.

b) The predicted distribution is weighted by a constant multiplier or by a weighting distribution before calculation of the cumulative sum and comparing as in a).

c) The predicted distribution is processed in some other way, for example a predefined function may calculate a value which is compared to a treshold value. Different bit rates can be weighted differently by construction of the predefined function. The admission control can be adjusted in many ways by choosing a suitable predefined function for obtaining the intended purpose: for example, to prefer low bit rate bearers or to prefer high bit rate bearers, or give preference to bearers having a bit rate within a specified bit rate range in order to guarantee better service to a certain service or a group of services. The function may also be constructed in such a way as to produce such admission control criteria, that all bearers are given equal preference regardless of their resource usage.

d) The treshold can be expressed as a distribution, which is directly compared with the predicted distribution. For example, the bearer can be refused, if the predicted distribution is higher than the treshold distribution at some load value.

Such embodiments of the invention which consider the existing bearers as distributions have the additional advantage, that a temporary deviation of the bit rate of a bearer from the nominal value does not affect the determination of the load. For example, if the load presented by a bearer is determined at any single instant, it might not represent the average load the bearer presents. This problem can be avoided by expressing the load presented by a bearer as a distribution, which represents the actual load more accurately than a single measurement.

Figure 3 illustrates a test according to the third example of a test of the first kind. First, the combined distribution of existing bearers is determined in step 110. The combined distribution may be determined for example by any of the previously described ways. In the next step 115, the distribution of the requested bearer is determined for example by selecting a distribution from a set of predefined distributions, which distribution has properties corresponding to the properties of the requested bearer. In the next step 120, the distribution of the requested bearer is combined with the distribution of all bearers to form a predicted distribution. If the predicted distribution is found to be outside the admission limits in step 125, the

request is refused in step 130 and the test is ended 140. If the predicted distribution is found to be within the admission limits in step 125, the bearer passes 135 this test and the test is ended 140.

A.4. Fourth example of a test of the first kind

In a further advantageous embodiment of the invention, the transmission power is taken into account when determining the load distributions. This gives a better representation of the actual load situation than only bit rate based distributions. The transmission power can be taken into account in several different ways, for example in one of the following ways:

- A distribution may represent the distribution of the received power of a bearer.
- A distribution may represent the distribution of received energy per bit of a bearer.
- A distribution may represent the distribution of the bit rate of the bearer, weighted by the average energy per bit value of a bearer.
- A distribution may represent the distribution of the bit rate of the bearer, weighted by the average energy per bit value of a bearer.
- A distribution may represent the distribution of the bit rate of a bearer, weighted with the probability distribution of the received power of the bearer.

However, the invention is not limited to only these examples of ways of constructing distributions indicating at least in part a measure of transmitted energy.

Since the energy per bit values may be difficult to determine, an estimate of the average energy per bit value may be obtained for example from an estimate of the average transmission power of the bearer and the average bit rate of the bearer.

In other respects, the embodiments according to the fourth example of a test of the first kind may use the methods described previously with bit rate distributions according to the third example of a test of the first kind, by replacing the bit rate distributions with distributions according to the fourth example of a test of the first kind.

A.5. Fifth example of a test of the first kind

The previously described third and fourth examples of a test of the first kind are computationally relatively intensive. To reduce the amount of calculations needed, the bearers can be treated in bearer groups to simplify the formation of the combined distribution of existing bearers. A bearer group is preferably a group of bearers having roughly similar BER requirement, i.e. roughly the same received energy per bit requirement. The bearers can also be grouped on the basis of the shape of their distributions.

The combined distribution of existing bearers can be determined for example as follows. First, the existing bearers are grouped to one or more bearer groups. Then, a distribution is determined for each group, preferably by selecting a distribution from a library of predefined distributions. Alternatively, certain bearer group types can be predefined, each with an associated predefined distribution. The distribution of each group is scaled to represent the total load represented by all of the bearers of the group. In the next step, the scaled group distributions are combined to form the combined distribution of existing bearers, preferably by convolving the distributions as described previously.

Next, the distribution of the requested bearer is determined. After that step, the predicted probability distribution is determined, which is preferably performed by combining the distribution of the requested bearer with the combined distribution of existing bearers.

Testing of whether the predicted distribution is within admission limits can be performed as described previously in the third example of a test of the first kind.

In a further embodiment according to the fifth example of a test of the first kind, the requested bearer is taken into account already before the combining of the group distributions. In such an embodiment, the requested bearer is taken into account by an additional scaling of the distribution of that bearer group, which most closely corresponds to the requested bearer. As a consequence, the result of the combining of group distributions is directly the predicted distribution.

Figure 4 illustrates a test according to the fifth example of a test of the first kind. In this example of an embodiment of the invention, the existing bearers are first grouped in bearer groups in step 205. In the next step 210, the distributions of the

bearer groups are determined for example by selecting from a set of predefined distributions, after which each distribution is scaled in step 215 to match the load presented by the corresponding group of bearers. The scaled group distributions are combined in step 220 to obtain a combined distribution of existing bearers. In the next step 225, the distribution of the requested bearer is determined for example by selecting a distribution from a set of predefined distributions, which distribution has properties corresponding to the properties of the requested bearer. In the next step 230, the distribution of the requested bearer is combined with the distribution of all bearers to form a predicted distribution. If the predicted distribution is found to be outside the admission limits in step 235, the request is refused in step 240 and the test is ended 250. If the predicted distribution is found to be within the admission limits in step 235, the bearer passes 245 this test and the test is ended 250.

B. Examples of tests of the second kind

The tests of the second kind concentrate on bearers, which require relatively large amounts of resources. Such bearers are denoted in the following by the term high load (HL) bearer. A bearer may be a HL bearer for example if the bit rate of the bearer is high, if the transmission power of the bearer is high, or the energy per transmitted bit E_b is high. The tresholds determining if a bearer is a normal i.e. a low load bearer or a high load bearer may be defined in many different ways according to the needs of the particular implementation of the invention, and the invention is not limited to any specific such treshold or way of determining whether a bearer is a HL bearer or not.

Since the bit rate of a bearer is straightforward to monitor, the bit rate can advantageously be used for determining whether a bearer is a normal or a HL bearer. The bit rate treshold for the determination can be adjusted for example by experimenting with different values of the treshold and choosing the value producing the optimum performance of the network. The bit rate treshold may be different in different control regions. Further, in some embodiments of the invention the network may adjust the bit rate treshold in a control region according to the traffic situation.

In the following examples of tests of the second kind, the first four present tests of the second kind, which can be used in a method according to figure 1, and the rest present tests of the second kind, which can be used in a method according to figure 2.

B.1. First example of a test of the second kind

According to a further advantageous embodiment of the invention, problems created by a skewed load is alleviated by preventing the admission of too many high load bearers to one control region. The admission or rejection of HL bearers is in an advantageous embodiment of the invention performed simply on the basis of the number of HL bearers already active in a control region. A new bearer passes this test if the following inequality holds:

$$HL_i + HL_{new} \leq HL_{th1} \qquad (8)$$

where

HL_i is the number of existing HL bearer in the control region i

HL_{new} is 1 if the new bearer is a HL bearer, otherwise 0, and

HL_{th1} is the predetermined maximum number of HL bearers in one control region.

The addition of 1 in equation (8) is not essential in various embodiments of the invention according to the first example of a test of the second kind. The test may simply be a comparison of HL_i to a treshold, in which case only HL bearers are required to pass this comparison.

B.2. Second example of a test of the second kind

In a further advantageous embodiment of the invention, the previously described first example of a test of the second kind is enhanced by taking the neighbouring control regions into account as well. In such an embodiment, the admission condition can be for example the following:

$$\sum_{i=1}^{nearbyBSs} HL_i + HL_{new} \leq HL_{th2} \qquad (9)$$

where HL_{th2} is the maximum number of HL bearers within the own control region and the considered neighbouring control regions. The sum is calculated over a desired number of nearby control regions, for example all directly neighbouring control regions.

Figure 5 illustrates a test according to the first or the second example of a test of the second kind. In figure 5, the existing high load bearers are counted in step 260. The counting may be done over the own control region as in the first example of a test of the second kind, or for example over the directly neighbouring control regions as in the second example of a test of the second kind. In the next step 265, the result is incremented by one, if the requested bearer is a high load bearer. In the next step 270 the result is compared to a predefined treshold value. If the result is larger than the treshold, the request is refused in step 280 and the test is ended. If the result is smaller than or equal to the treshold, the bearer is determined to pass 275 this test and the test is ended 285.

B.3. Third example of a test of the second kind

In a further advantageous embodiment of the invention, instead of the number of HL bearers as in equations (8) and (9), the admission condition can be based on the sum of bit rates of HL bearers in a control region or a group of control regions. This sum is then compared to a predefined treshold sum. If the predefined treshold sum is smaller than the sum of bit rates, the requested bearer is refused.

In a still further advantageous embodiment of the invention, the admission condition is based on the sum of bit rates of HL bearers as a percentage of total combined bit rate of all bearers within a control region or a group of control regions. This percentage sum is then compared to a predefined treshold percentage value. If the treshold value is smaller than the sum, the requested bearer is refused.

B.4. Fourth example of a test of the second kind

In a further advantageous embodiment of the invention, the admission condition can be based on the sum of transmission power of existing HL bearers in a control region or a group of control regions. The sum is compared to a predefined treshold value, and if the treshold value is smaller than the sum, the requested bearer is refused.

B.5. Fifth example of a test of the second kind

In a further advantageous embodiment of the invention, the result of a test of the second kind is used to control the admission treshold used in a test of the first kind.

This may be effected in many different ways, examples of which are presented in the following.

- For example, the admission treshold may be changed by a predefined amount if one or more HL bearers already exist.
- For example, the admission treshold may be changed by a predefined amount once for each HL bearer already existing.
- For example, the sum of bit rates of HL bearers may be computed and the sum compared to a predefined maximum value, and the admission treshold may be changed according to the ratio of the sum to the predefined maximum value.
- For example, the total transmission power of HL bearers may be determined and compared to a predetermined maximum value, and the admission treshold may be changed according to the ratio of the total transmission power and the predetermined maximum value.

However, the invention is not limited to these examples of ways, in which the admission treshold used in a test of the first kind can be changed according to the result of a test of the second kind. Other ways may be used in various embodiments of the invention. For example, in some embodiments of the invention the HL bearers in neighbouring control regions are taken into account.

B.6. Sixth example of a test of the second kind

In those embodiments of the invention, in which bearers are processed as distributions and a predicted distribution is obtained in the test of the first kind, the admission control adjustment may be effected in a wide variety of ways depending on how the predicted distribution is determined to be within admission criteria or outside the admission criteria. In such an embodiment the admission criteria can be adjusted uniformly for all bearers, or adjusted to be stricter to certain bearer types only. For example, the admission criteria can be adjusted to be stricter for new HL bearers while retaining the previous admission criteria for normal bearers.

Further, instead of adjusting the predefined admission limits, the processing of the predicted distribution can be adjusted for effecting the desired changes in admission requirements. For example, the predicted distribution can be weighted with a suitable distribution emphasizing the high bit rate values, which results in less resources being available to high load bearers. Further, if a predefined function calculates a value based on the predicted distribution, and this value is then

compared to a predefined treshold for obtaining the admission decision, the function can be changed for effecting the desired changes in admission requirements.

C. Further considerations

In various embodiments described previously, the estimated increase Prx_dB_{inc} in received power due to a new bearer is estimated with the help of a load curve. A load curve can be obtained as follows. It is generally known that SIR value SIR_i of a bearer i may be calculated as

$$SIR_i = PG_i \cdot \frac{Prx_i}{\sum_{\substack{J=1 \\ j \neq i}}^{N} Prx_j + P_a} \tag{10}$$

where PG_i is the processing gain of the bearer, Prx_i is the received power of the bearer i, the sum in the denominator is performed over the received power of other bearers, and the term P_a denotes other interference sources and noise. From this follows

$$\frac{SIR_i}{PG_i} = \frac{Prx_i}{\sum_{\substack{J=1 \\ j \neq i}}^{N} Prx_j + P_a} \tag{11}$$

Summing SIR_i / PG_i over many bearers and allowing the number of bearers go to infinity, we obtain the limit

$$\sum_{i=1}^{N} \frac{SIR_i}{PG_i} \xrightarrow[N \to \infty]{} 1 \tag{12}$$

A load curve can be obtained by plotting $\sum Prx_i$ as a function of $\sum (SIR_i / PG_i)$. An example of a load curve is given in figure 6. The load curve has an roughly linear portion in the middle. The coefficient k mentioned previously can be obtained from the load curve as the slope of a part of the roughly linear portion of the load curve. The coefficient k can also be found out by measuring the received total power level, i.e. $\sum Prx_i$, at different traffic situations with different numbers of active bearers i.e. at different values of $\sum (SIR_i / PG_i)$, and fitting a straight line

into the measurement data. The slope of the line may then be used as the coefficient k.

The method according to the invention can be used as well in bearer negotiations i.e. if a first bearer request does not pass, a second bearer request with different parameters can be examined and so on, until admissible bearer parameters are found.

The method according to the invention can advantageously be used in a radio network controller (RNC) or other cellular telecommunications network element performing admission control. The method according to the invention can advantageously be applied in the UMTS cellular telecommunication system and other telecommunications systems at least partly based on the CDMA technology. The name of a given functional entity, such as the radio network controller, is often different in the context of different cellular telecommunication systems. For example, in the GSM system the functional entity corresponding to a radio network (RNC) is the base station controller (BSC).

D. Further embodiments of the invention

According to an advantageous embodiment, means for realizing the inventive method are incorporated in a network element of a telecommunications network. One example of such a network element is the radio network controller of a cellular telecommunications network. Figure 7 illustrates one example of such an embodiment. Figure 7 shows mobile stations 505 which are in radio connection with base stations 510. The base stations are connected to and controlled by a radio network controller 520, which is in turn connected to rest of the cellular telecommunications network 550. The cellular telecommunications network may, for example, be the UMTS cellular telecommunications network presently under development. According to this embodiment, the radio network controller comprises means 521, 522, 523 for testing a bearer request according to a test of a first kind and for producing a first test result, means 521, 522, 524 for testing a bearer request according to a test of a second kind and producing a second test result, and means 521, 522, 525 for deciding about admission of the bearer on the basis of said first and second test result. These means may be for example, a processing unit 521 such as a microprocessor 521 or a digital signal processor 521, a memory unit 522 comprising programs 523, 524, 524 executed by the processing unit 521 for performing the test of the first kind and test of the second kind and producing the

admission or rejection decision based on the results of the tests for example according to the examples of methods recited previously.

The treshold values of admission conditions do not need to be permanently fixed values. The treshold values may be adjusted by the controlling entity of the control region or another element of the cellular telecommunications network in various embodiments of the invention, for example to optimize the resource usage of the network.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention. While a preferred embodiment of the invention has been described in detail, it should be apparent that many modifications and variations thereto are possible, all of which fall within the true spirit and scope of the invention.

Claims

1. Admission control method in a telecommunications network, **characterized** in that
in the method,
- a bearer request is tested with a test of a first kind, and
- said bearer request is tested with a test of a second kind,
said test of said second kind monitoring especially bearers which present to the network a load which exceeds a predefined treshold,
the admission of said bearer request being dependent on the results of both said test of said first kind and said test of said second kind.

2. Admission control method according to claim 1, **characterized** in that said test of a first kind is based on statistical properties of bearers.

3. Admission control method according to claim 1, **characterized** in that in said test of a second kind the number of currently existing high load bearers is compared to a predefined treshold.

4. Admission control method according to claim 1, **characterized** in that in said test of a second kind the sum of bit rates of currently existing high load bearers and of the requested bearer is compared to a predefined treshold.

5. Admission control method according to claim 1, **characterized** in that the admission criteria of said test of said first kind are changed according to the results of said test of said second kind.

6. Admission control method according to claim 5, **characterized** in that an admission treshold of said test of said first kind is changed by a predefined step, if at least one high load bearer exists already.

7. Admission control method according to claim 6, **characterized** in that an admission treshold of said test of said first kind is changed by a second predefined step for each high load bearer existing already.

8. Network element for a telecommunications network, **characterized** in that the element comprises

- means for testing a bearer request according to a test of a first kind and for producing a first test result,
- means for testing a bearer request according to a test of a second kind and producing a second test result, and
- means for deciding about admission of the bearer on the basis of said first and second test result.

9. Network element for a cellular telecommunications network according to claim 8, **characterized** in that the network element is a radio network controller.

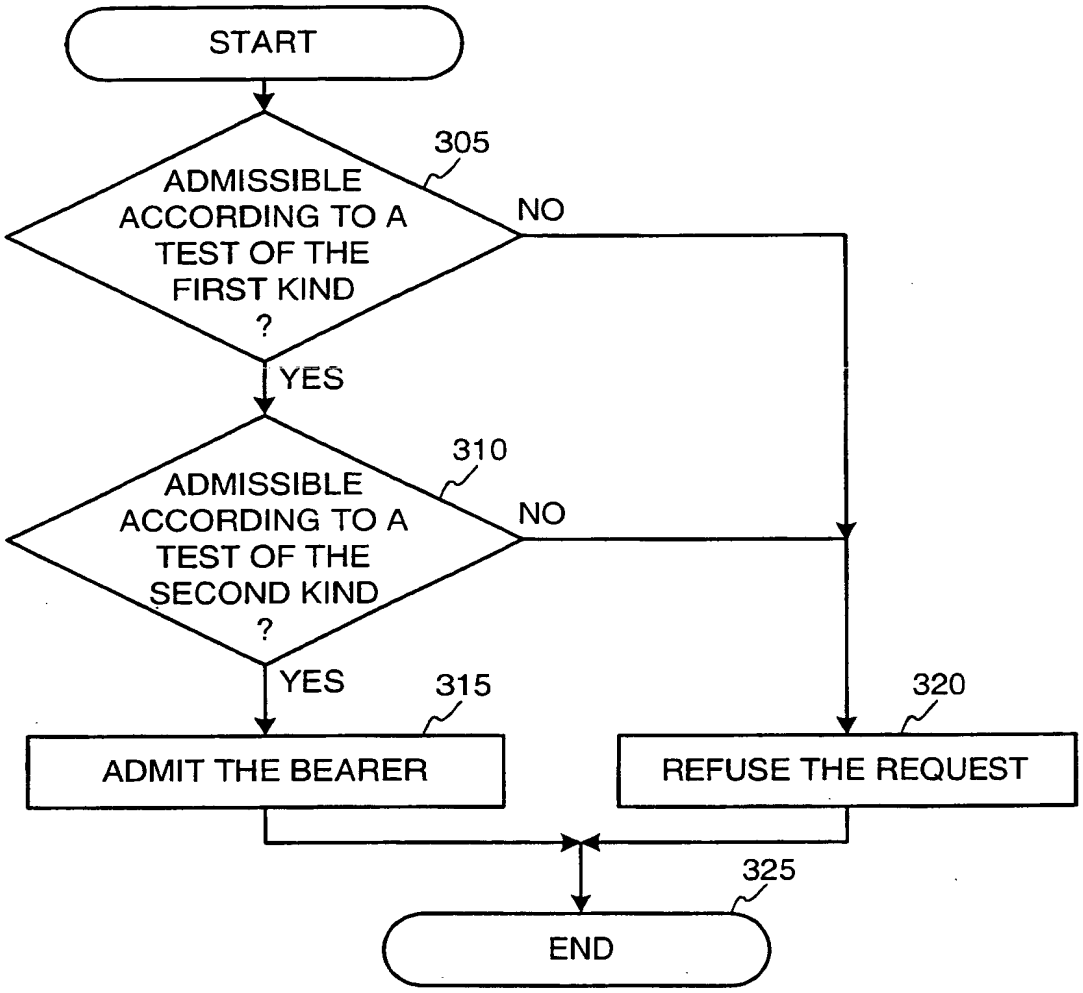
START
305
ADMISSIBLE ACCORDING TO A TEST OF THE FIRST KIND ?
NO
YES
310
ADMISSIBLE ACCORDING TO A TEST OF THE SECOND KIND ?
NO
YES
315
ADMIT THE BEARER
320
REFUSE THE REQUEST
325
END

Fig. 1

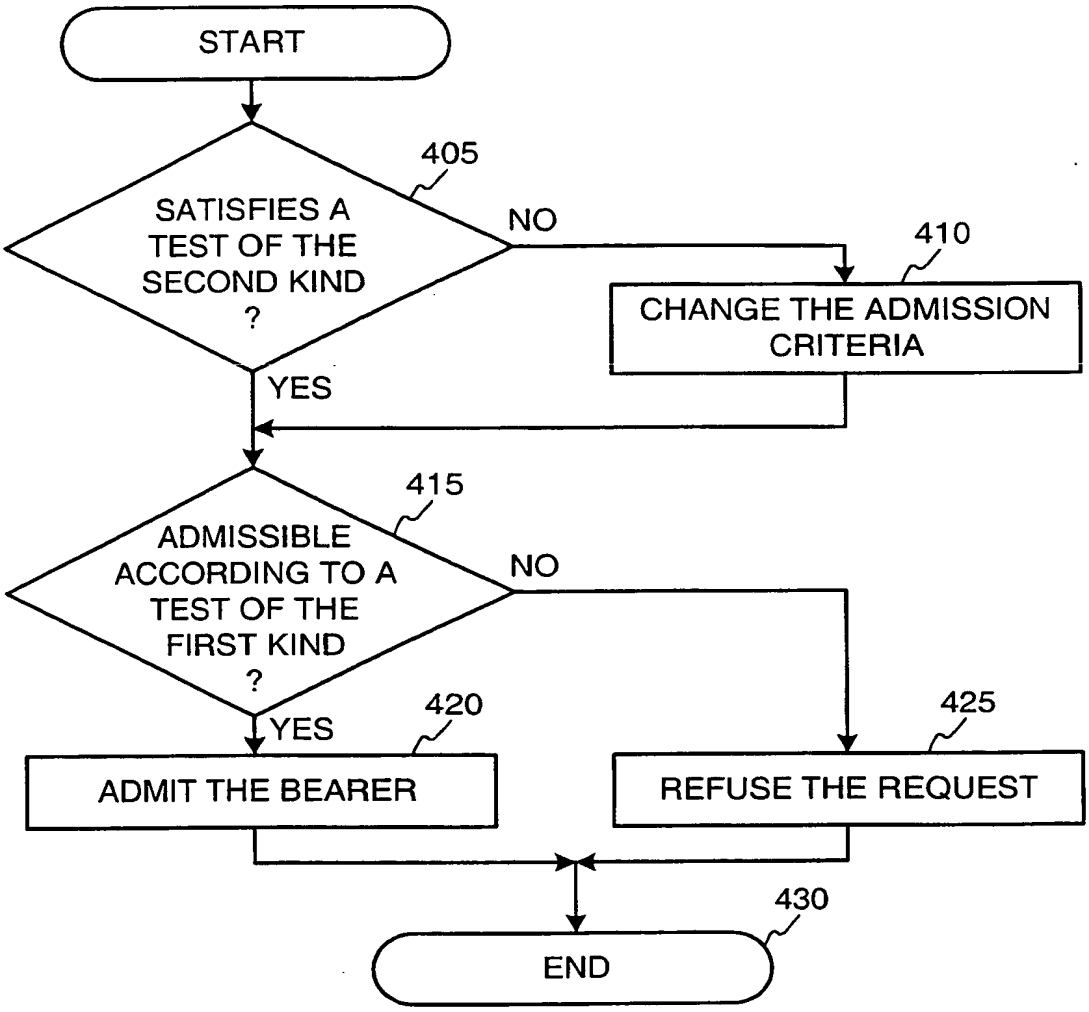
START
405
SATISFIES A TEST OF THE SECOND KIND ?
NO
410
CHANGE THE ADMISSION CRITERIA
YES
415
ADMISSIBLE ACCORDING TO A TEST OF THE FIRST KIND ?
NO
YES
420
ADMIT THE BEARER
425
REFUSE THE REQUEST
430
END

Fig. 2

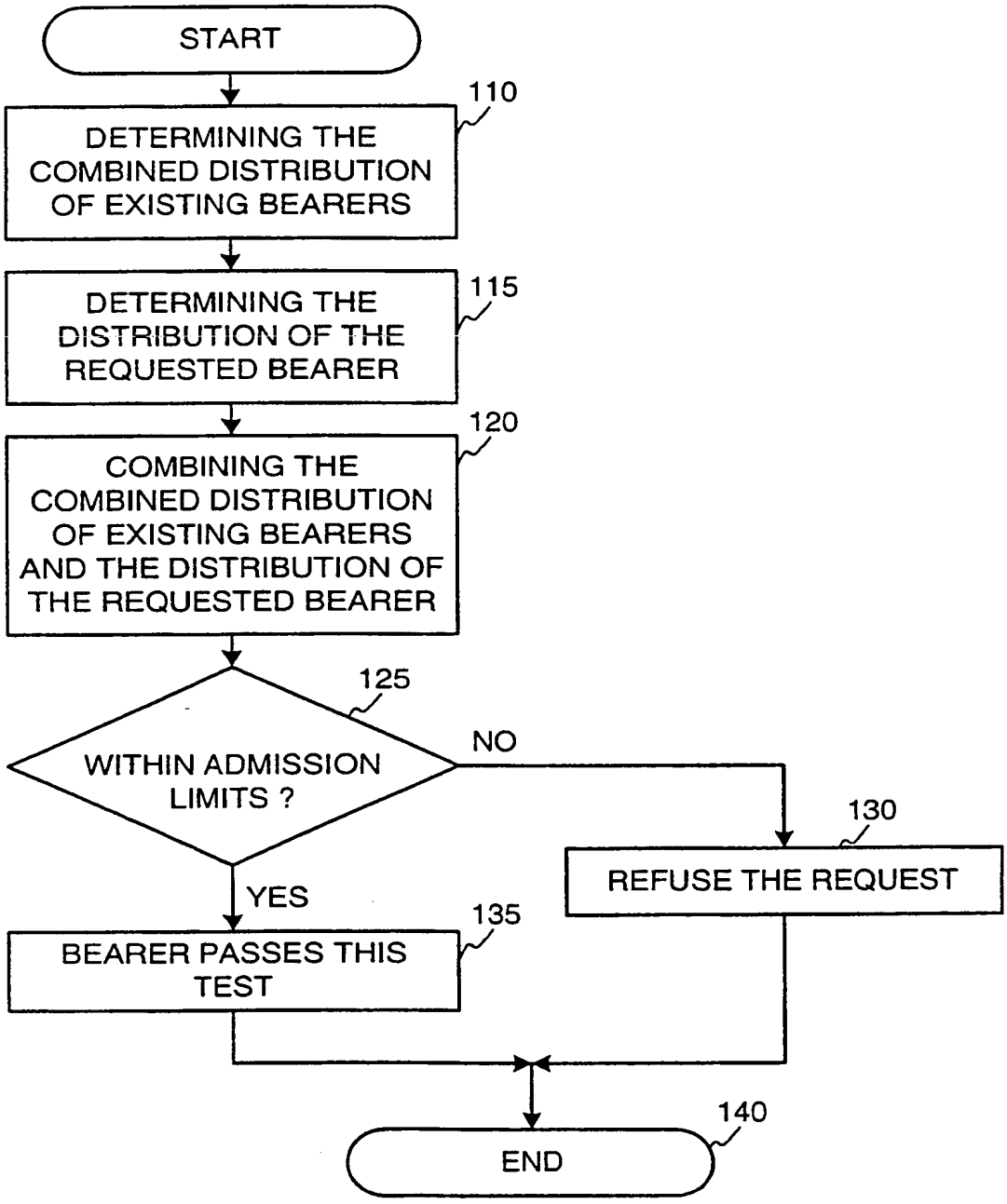
START
110
DETERMINING THE COMBINED DISTRIBUTION OF EXISTING BEARERS
115
DETERMINING THE DISTRIBUTION OF THE REQUESTED BEARER
120
COMBINING THE COMBINED DISTRIBUTION OF EXISTING BEARERS AND THE DISTRIBUTION OF THE REQUESTED BEARER
125
WITHIN ADMISSION LIMITS ?
NO
130
REFUSE THE REQUEST
YES
135
BEARER PASSES THIS TEST
140
END

Fig. 3

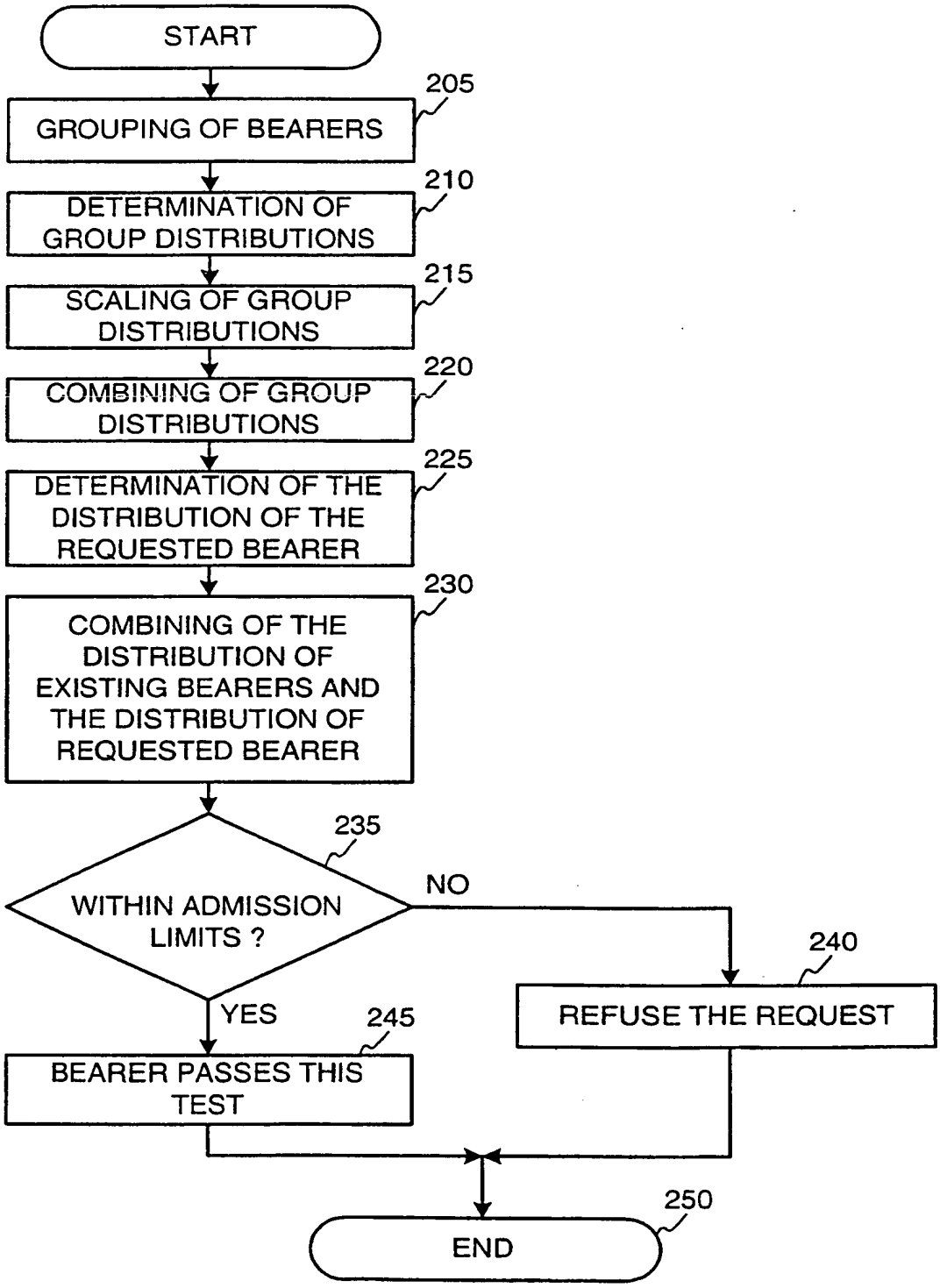
START
205
GROUPING OF BEARERS
210
DETERMINATION OF GROUP DISTRIBUTIONS
215
SCALING OF GROUP DISTRIBUTIONS
220
COMBINING OF GROUP DISTRIBUTIONS
225
DETERMINATION OF THE DISTRIBUTION OF THE REQUESTED BEARER
230
COMBINING OF THE DISTRIBUTION OF EXISTING BEARERS AND THE DISTRIBUTION OF REQUESTED BEARER
235
WITHIN ADMISSION LIMITS ?
NO
240
REFUSE THE REQUEST
YES
245
BEARER PASSES THIS TEST
250
END

Fig. 4

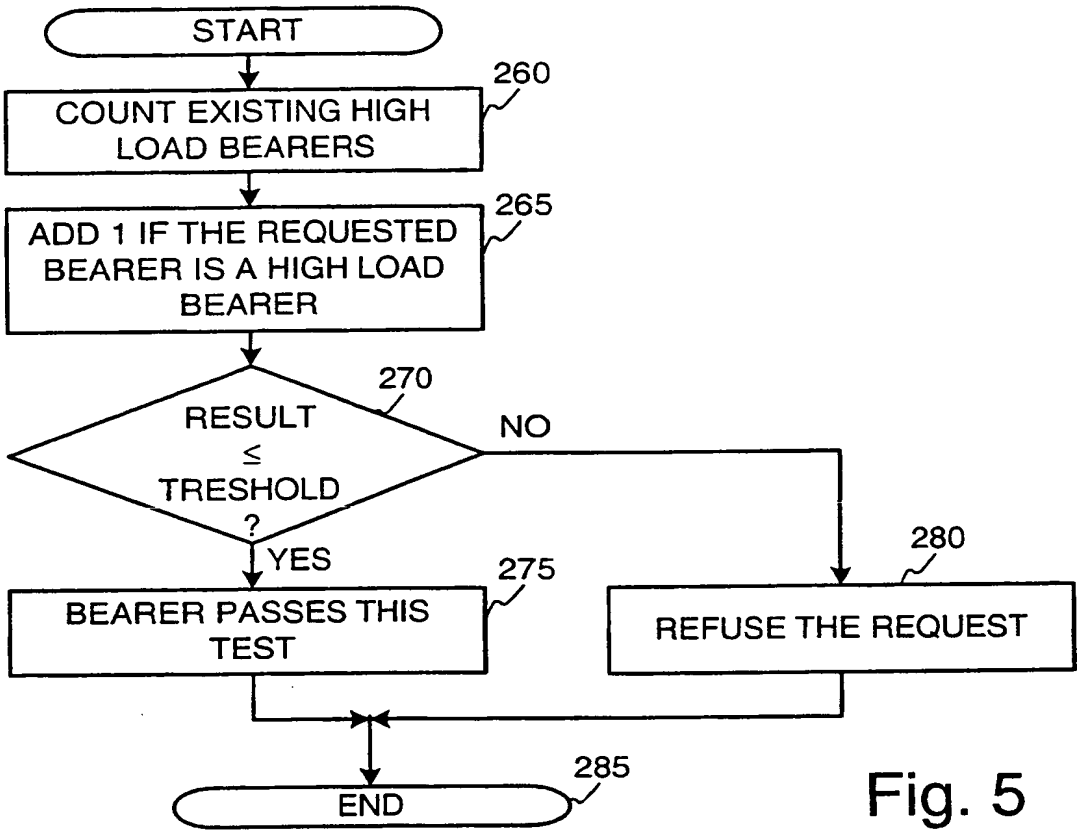
START
COUNT EXISTING HIGH LOAD BEARERS
260
ADD 1 IF THE REQUESTED BEARER IS A HIGH LOAD BEARER
265
RESULT ≤ TRESHOLD ?
270
NO
YES
BEARER PASSES THIS TEST
275
REFUSE THE REQUEST
280
END
285

Fig. 5

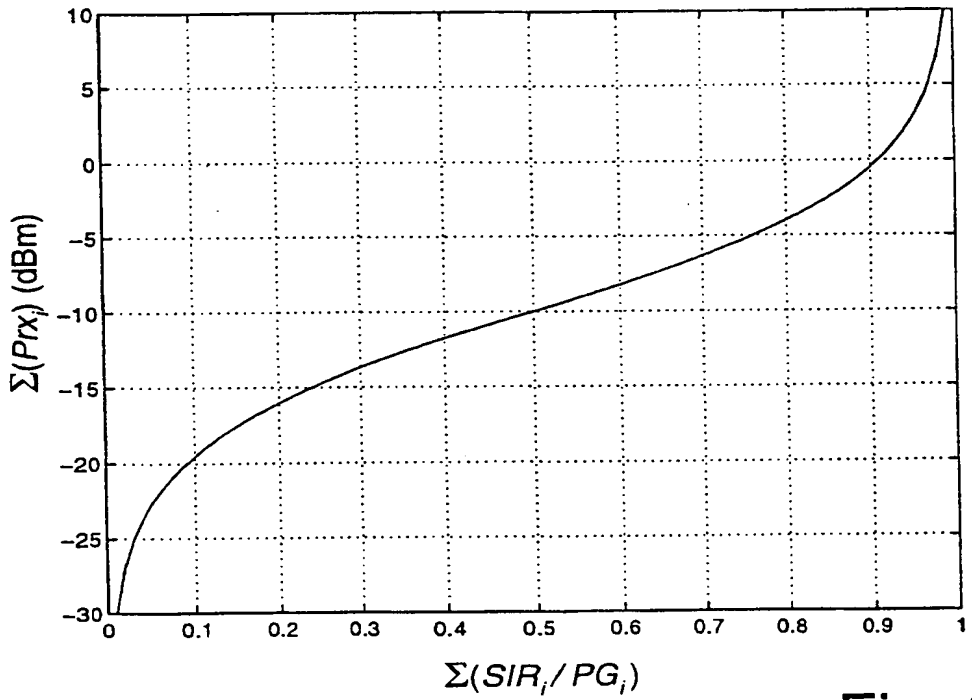
10
5
0
−5
−10
−15
−20
−25
−30
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Σ(Prx_i) (dBm)
Σ(SIR_i / PG_i)

Fig. 6

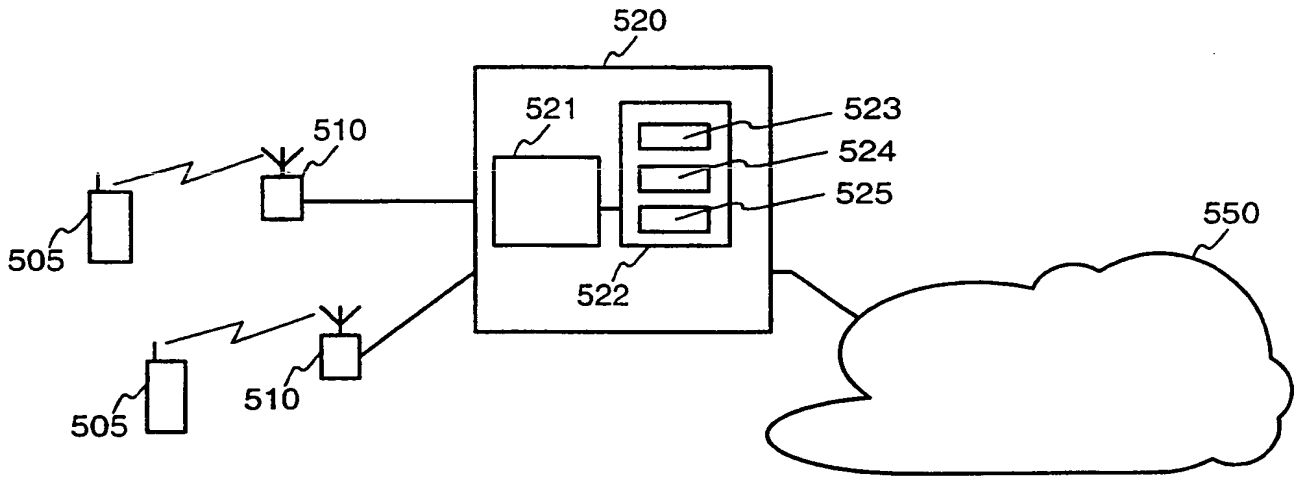

Fig. 7

INTERNATIONAL SEARCH REPORT

[redacted]ional Application No
PCT/FI 99/00794

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 497 504 A (ACAMPORA ANTHONY S ET AL) 5 March 1996 (1996-03-05) column 5, line 28 - line 42 column 6, line 41 -column 7, line 14 column 7, line 31 -column 8, line 13 figure 5	1-3,8,9
A	US 5 666 348 A (THORNBERG CARL MAGNUS ET AL) 9 September 1997 (1997-09-09) column 2, line 25 - line 58 column 13, line 6 - line 43	1,8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2000	28/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax (+31–70) 340–3016	Dionisi, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[redacted]ation on patent family members

[redacted]ional Application No
PCT/FI 99/00794

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5497504 A	05-03-1996	AU 2588695 A	05-12-1995
		WO 9531868 A	23-11-1995
US 5666348 A	09-09-1997	AU 7005196 A	09-04-1997
		CN 1201583 A	09-12-1998
		EP 0852102 A	08-07-1998
		JP 11512593 T	26-10-1999
		WO 9711570 A	27-03-1997